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NOTES ON THE HABITS AND DEVELOPMENT OF THE FOUR-TOED SALAMANDER, HEMIDACTYLIUM SCUTATUM (SCHLEGEL)

BY
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NOTES ON THE HABITS AND DEVELOPMENT OF THE FOUR-TOED SALAMANDER, HEMIDACTYLIUM SCUTATUM (SCHLEGEL)

BY SHERMAN C. BISHOP

The four-toed salamander, Hemidactylium scutatum (Schlegel), although widely distributed has been considered uncommon in almost every locality from which it has been recorded. So little has been written concerning the habits of this species that an account of the finding of the animal and its eggs in abundance and a description of some of the stages of its development may prove of interest and throw some light on questions involving metamorphosis and habits not heretofore answered.

The genus Hemidactylium, represented by the single known species, is closely related to Plethodon from which it differs structurally in the absence of the fifth toe on the hind foot and, in a slight degree, in the number and arrangement of the teeth. If the deficiency in digits be disregarded, there is no more diversity in the characters of Hemidactylium and Plethodon than is found in members of the genus Plethodon itself. From the genus Batrachoseps, after which it is usually placed, it differs, according to Cope ('89), in having a prefrontal bone. In common with other members of the family Plethodontidae, the four-toed salamander is lungless. Of the several species of Plethodon, it is most nearly related to P. cinereus, both in structure and habits. Like that species, it has the tongue attached medially in front with the side margins free; but the median line of attachment in H. scutatum is confined to the anterior half, while in P. cinereus it is continued almost to the posterior margin.

Parasphenoid teeth in H. scutatum in two elongate areas well separated; in P. cinereus these areas are almost contiguous; vomero-palatine teeth in two crescent shaped patches and more numerous than in P. cinereus. Externally H. scutatum differs markedly from P. cinereus in the color of the head, trunk and under parts, in its less robust form, and by having but four toes on the feet.

In its adaptation to terrestrial life the four-toed salamander again approaches the red-back (P. cinereus), although in this respect it has not gone as far.

The following description of the female is from a living, mature specimen found coiled about her eggs May 30, 1919. Total length, 75 mm; tail, 42.4 mm; head, length, 8 mm, width, 5.6 mm (behind eyes). Color: head and trunk above dark reddish brown, becoming grayish on the lower part of the sides between the costal grooves; snout, lighter, bronzy; upper side of limbs and tail with a ground color of reddish orange blotched with darker brown; a small, elongate, light reddish patch on shoulders above the arms and less distinct specks of the same color in the costal grooves on the back. Below, bluish white with irregular flecks of black mostly distributed along the sides; center line of tail free from spots, that of belly nearly so.

The head is broad and flat, with the sides nearly parallel; the snout blunt; the eyes are prominent and more or less retractile; trunk cylindrical and short; tail long, the posterior half keeled indistinctly above and below. Constriction at base of tail prominent, a short distance behind anus. The limbs are slender but strong; fingers and toes four, the inner and outer rudimentary.

A distinct median dorsal groove originates near the base of the tail and extends onto the head where it bifurcates and sends a branch to each eye (plate 3, figure 2); thirteen or fourteen costal grooves, the upper extension of which meet the dorsal groove at an acute angle; gular fold prominent, continuing onto the neck where it meets a lateral groove extending to the eye. The entire surface of the skin has a finely pitted or granular appearance.

Moesel ('18) states that the male is usually darker on the dorsal surface of the body than the female, and that the ventral surface is somewhat differently marked, that is " . . . is milky-white with large inky-colored spots along the edges of the belly, throat and pectoral regions. The abdominal region is devoid of spots." C. and H. Thompson record specimens of both sexes taken from beneath a log in April in which the females were, ". . . fully twice as large as the males." I have no specimens of males and am unable to add to the above accounts.

A half-grown specimen 30.4 mm long, anomalously colored, has a striking resemblance to some specimens of Plethodon cinereus. The red of the back of the tail in young four-toed salamanders is often continued well forward over the trunk but in this specimen the ventral surface is also aberrantly marked. Instead of irregular black spots distributed mostly along the sides of the belly and tail, this specimen has dull-brown spots (on a bluish ground) more or less uniformly spread all over the venter (plate 5, figures 1 and 2).

Distribution

The range of Hemidactylium as given by Stejneger and Barbour ('17) is as follows: "Massachusetts, southern Canada westward to Michigan, south to Georgia and the Gulf States, also Arkansas and Illinois." West of the Mississippi it has been recorded from Hot Springs, Arkansas and Bourbon, Crawford county, Missouri (Hunter and Strecker, '09). It will undoubtedly be found in all New England states if search be made at the proper season of the year in the somewhat restricted habitat in which it occurs during the period of egg deposition and development.

The species was added to the fauna of New York State by S. F. Baird, who presented living specimens to the State Cabinet of Natural History in 1851. These specimens with several of other species, "were all caught in the course of an hour, on the farm of Joseph C. Tiffany, Esq., near Coxsackie." (Baird '52). This early record was evidently overlooked by Paulmier ('02), in the "Lizards, Tortoises and Batrachians of New York," as the following statement under the account of the species indicates: "Probably to be found in this State."

In the Cayuga lake basin where the species has probably been more frequently taken than elsewhere in the State, it has been considered uncommon. Some early records given in "The Vertebrates of the Cayuga Lake Basin, N. Y.," by H. D. Reed and Albert H. Wright ('09) are here quoted: "The first specimens were obtained near Ithaca in the valley of Sixmile creek by H. W. Norris in April, 1889. No other specimens were found in this basin until October 22, 1905, when twenty-one specimens were found on Larch hill, two miles south of Ithaca on the east side of the inlet valley. They were all found under stones or about the bases of stumps in the open."

For the following records from the vicinity of Ithaca, N. Y., I am indebted to Miss Julia Moesel of Elmira College who kindly permitted use of that part of her master's thesis (Cornell '18) pertaining to the four-toed salamander: "April 6, 1914, three females were taken in Enfield gorge. A single specimen was taken in the evergreen woods at Ellis Hollow on May 16, 1916." "On April 16, 1914 . . . upon the hillside overlooking the inlet of

Cayuga lake and about 40 feet over the roadway . . . two families of four-toed salamanders were taken. One family consisted of a single adult, a female, and three young, while the second included a male, a female and three young, each about 1.8 cm long."

"On October 9, 1916, three individuals were discovered at the base of the same hillside, almost at a level with the roadway. Here they were concealed beneath the stones, one specimen hiding upon the earth surface, the other two having been unearthed from burrows about 6 or 7 inches below the surface. About three weeks later, on October 29th, five varying-sized individuals were taken from beneath stones lying in a direct line about half way up the hillside."

On October 28, 1917, Henry Dietrich took two adult specimens from beneath stones on Larch hill. R. F. Deckert ('14) records Hemidactylium from Silver Lake Park where he says that it has been repeatedly taken, usually in or under logs.

Ditmars ('05) states that the species in the vicinity of New York City is mostly distributed along the Palisades of the Hudson river. Mearns ('98) records a single specimen from the Hudson highlands taken in October, 1896. In the collections of the State Museum is a specimen from Orient Point, Long Island, received May 6, 1911; three specimens from Altamont, N. Y., taken October 12, 1906, and a single individual from Elizabeth island, Lake George, taken by the writer from beneath a log August 2, 1917.

Habitat

Published accounts usually record this species from terrestrial situations. According to Ditmars (ibid.), "It is strictly terrestrial and inhabits timbered regions, where it hides under logs and stones." By Sherwood ('95), it was found in the open woods where grass was growing; "All were under stones and curled. Single specimens taken at Harrington, N. J., from under boards of logs about 5 feet from a pond. Time of captures May and June." W. H. Smith ('82) " . . . Found in April under old logs and rails in open woods at some distance from the water." C. and H. Thompson, ('12) state that specimens were "found (May 13, 1901) in earth on the roots of a violet which had been pulled up"; "under loose moss"; "April, 1902, under a log"; "one was just inside the bark of a rotten stump." On Larch hill, near Ithaca, specimens were found under stones and the bases of stumps. Reed and Wright (ibid).

Specimens recorded by Moesel from hillsides near Ithaca, "were taken from beneath large, flat stones which were well imbedded and surrounded by a mass of shrubbery." Others, as before noted, were found buried to a depth of 6 or 7 inches.

A few specimens have been taken in situations less terrestrial. In his account of the Batrachia and Reptilia of Onondaga county, Britcher ('03) includes a single specimen taken in sphagnum moss in a swamp on the Jamesville road. I am indebted to Mrs A. A. Wright of Ithaca for a similar record. On June 11, 1916, while searching for a small orchid, Listera australis, Mrs Wright found a specimen in the sphagnum of the Duck Lake bogs, about 7 miles north of Savannah, N. Y.

The base of Larch hill, above mentioned, is bordered on the west by a broad meadow formerly with large areas of sphagnum but now being fast converted by ditching operations into land suitable for cultivation. On June 16, 1919, Dr A. H. Wright and the writer visited this locality but a thorough search failed to reveal a single specimen of the four-toed salamander. Although few specimens had been actually recorded from sphagnum bogs, the intimate association of the species with this type of environment was pointed out by Wright ('18) who stated, "The four-toed salamander (Hemidactylium scutatum) . . . is vanishing with the drying up or draining of sphagnum bogs and feather bed swamps." It is certain that the final conversion of sphagnum areas will mark the extirpation of the species in such localities, unless in their progressive adaptation to terrestrial life, they select more varied situations for deposit of eggs.

General Habits

The habit of coiling up when disturbed or exposed was observed by Sherwood (ibid.) and independently by A. H. Wright, who expressed the opinion that the habit was perhaps correlated in some way with the attendance of the female upon the eggs; a conjecture verified to some extent by subsequent observations. Two habits of Plethodon cinereus, leaping and autotomy of the tail, described by Piersol ('09) as of rare occurrence among Urodeles, have both been observed in Hemidactylium. The leaping process in the latter, however, seems to be accomplished more by violent contortions of the body and tail than by use of the limbs.

Although several individuals were taken in the field with tails in various stages of regeneration, the inclination to part with this member was not particularly evidenced in specimens handled in captivity. One very active salamander, however, too roughly treated, left its tail wriggling on my desk and started to crawl away. With preserved specimens, the greatest care in handling is required to keep body and tail together.

The definite constriction at the base of the tail in Hemidactylium marks the line of separation of the skin in autotomy (plate 3, figures 1-2-3). A short distance in front of this constriction there is a less prominent depressed line which indicates the point of detachment of muscles and vertebrae. By this provision the skin, on separation, is of sufficient length to cover the wound of the stub over which it immediately shrinks. The detached portion of the tail wriggles violently for a few minutes and if stimulated by pinching or with acetic acid the contortions continue for a longer time.

A specimen in captivity was induced to cast off the tail by touching the back with a drop of dilute acetic acid. A single violent wrench of the body sufficed to separate it from the tail. Plethodon eschscholtzii (oregonensis) is said to have a constriction similar to that of Hemidactylium and in addition well-developed dorsal glands of the tail. In P. cinereus there is no such specialized device or great development of dorsal glands, autotomy occurring at almost any point back of the anus. The provisions for protection of the wound noted in Hemidactylium are practically those observed by Piersol (ibid.) in Plethodon.

Well hidden beneath stones or bark or buried deep in sphagnum moss for the greater part of the year and doubtless further protected by disagreeable secretions of the skin, this salamander probably has comparatively few enemies. The greatest danger must occur during migration or at night if it be given to nocturnal ramblings.

The food of Hemidactylium probably consists principally of insects. C. and H. Thompson (ibid.), observed it to take small flies in captivity. O. P. Hay ('92) states, "The food is said to consist principally of worms and insects." The stomach of a female taken at Ringwood (near Etna), N. Y., May 20th, contained the larva of one of the Micro-lepidoptera (Crambinae and probably of the genus Crambus) and the remains of some small Staphylinids. Sphagnum moss and bog litter in general contain a varied and extensive fauna of the smaller invertebrates which undoubtedly contribute to the support of Hemidactylium and other bog-dwelling forms. Spiders, mites, beetles and Thysanura are particularly numerous. Larvae of various species of Lepidoptera and pseudoscorpions occur; even amphipods are sometimes found.

I have not observed internal parasites in the adult salamanders but the gelatinous envelops of several of the eggs were infested with small nematodes that moved about in the semifluid mass.

That there is an increasing adaptation to terrestrial life and increasing degree of parental care of eggs and larvae in the series represented by Ambystoma, Desmognathus, Plethodon and Oneides (Autodax) has been pointed out by Piersol. In this series may be placed Hemidactylium which in adult life is as terrestrial as Plethodon and more so than Desmognathus. The egg complement (40–60) of Hemidactylium, however, is larger than that of Desmognathus (15–20, Hilton, '09) or of Plethodon (3–12, Piersol, '09) and the eggs are laid in situations which are in closer relation to water than those of either of the other species. The larger number of eggs and the fact that they are deposited in situations that give them abundant and constant supply of moisture, may be an indication of more recent adaptation to terrestrial life; if so, Hemidactylium has gone farther and faster than Desmognathus fusca, both in the larval and adult condition.

Breeding Habits

Very little has been published concerning the breeding habits of Hemidactylium. O. P. Hay (ibid.) stated that the eggs were found in moss at the roots of trees that stood near ponds, and that they were said to resemble the eggs of P. cinereus. Cope is reported as saying that the gills are absorbed at an early period in life and that the animal never enters the water. Ditmars (ibid.) expressed the opinion that the young possessed branching gills when hatched but lost them in a few days. As no specimens were mentioned, the statements of Cope and Ditmars may have been conjectures based on general knowledge of related forms. In their account of the species, C. and H. Thompson remarked, "The eggs are laid under moss or bark, and the salamander at least in the adult condition avoids water."

Moesel ('18) examined the ovarian eggs of specimens taken April 11, 1917, on Larch hill and June 11, 1916, at Duck lake and found them to be of large size, 2 mm in diameter. She states further that they were pigmented, a little less than half of the egg being "of a dark grayish brown shade." Fifty-three eggs were found in the first specimen examined and fifty-seven in the other. The conclusion was reached that the period of ovulation occurred during late April or early May in the vicinity of Ithaca and somewhat later in the vicinity of Duck lake. The ovarian eggs observed by Moesel correspond closely in number to those actually found in the field where complements were noted containing, on the average, about fifty. These notes constitute practically all that has been recorded concerning breeding habits of the species.

On May 14, 1919, the writer, while sifting for spiders with Prof. C. R. Crosby of Cornell University, found the eggs of the four-toed salamander with the female coiled about them in the bogs of the Mud pond basin near McLean, N. Y.

The McLean bogs are part of a series extending in a northeast-southwest direction between Ithaca and Cortland, N. Y. Originally of considerable area, the actual sphagnum-heath formations are now of comparatively small extent and diminishing with the encroachment of grass and shrub and tree. Mud pond itself (plate I, figures 1 and 2) is surrounded by bushy swamps and grass bogs with occasional patches of sphagnum and other mosses scattered about the margin among the clumps of shrubs. A characteristic shrub, herb and sphagnum association on the border of this pond may be presented as a typical habitat of Hemidactylium during the period of deposition and incubation of the eggs.

The common woody shrubs are represented by clumps of red-osier dogwood (Cornus stolonifera), hoary alder (Alnus incana), and an occasional shad bush (Amelanchier sp). A few seedlings of the arrow-wood (Viburnum dentatum) and vines of Clematis virginiana find root among the larger shrubs. The herbaceous plants consist principally of small groups of meadow rue (Thalictrum polygamum), white violet (Viola blanda), touch-me-not (Impatiens biflora), water pennywort (Hydrocotyle americana) and scattered single plants of the cuckoo flower (Cardamine pratensis). In the open water spaces between, the marsh marigold (Caltha palustris) and other bog-loving forms are scattered. Rank growths of sphagnum and other mosses cover the roots and bases of the shrubs and in these masses of moss the four-toed salamander lays her eggs (plate 2, figures 1 and 2).

In every instance the eggs were found buried to a depth of 3 or 4 inches in the moss and within 6 inches of the water. In every instance the female was found either partly coiled upon the eggs or about them. When disturbed the female often made an effort to escape by burrowing in the moss but sometimes she seemed inclined to stay with her eggs. It is almost impossible to find the eggs of Hemidactylium without disturbing their position somewhat in removing the covering of moss, but in general it may be stated that they are disposed in a mass and are stuck firmly together and to rootlets, and stems of moss (plate 4, figures 1–3).

The first lot of eggs found (May 14th) contained ninety, but were probably the complements of two females as a second was seen but not captured. Subsequent observations on the number of eggs deposited strengthen this conjecture. On May 27th A. H. Wright and the writer again visited the bogs, and other specimens were found in like situations within a few feet of the former. At this time, a female and her eggs, about fifty, and a female without eggs were taken. A third specimen was left as found partly coiled about her eggs. On June 30th A. H. Wright found that this female and her brood had departed. On May 27th Henry Dietrich of Cornell University, while collecting at the Ringwood bogs near Etna, N. Y., found one adult and two half-grown four-toed salamanders in the moss near water. One week before two adults were taken by him in the same place.

As the first female taken, confined too closely, failed to survive transportation from McLean to Ithaca, the unattached female taken May 27th was placed with the original lot of eggs which she soon appropriated and coiled about.

Other parts of the margin of Mud pond were explored May 30th and nine more egg masses found, in each case as before, within 6 inches of the water and attended by the female. In one side of a small clump of sphagnum were four females and a total of 204 eggs; the egg masses were not distinctly separated, in fact so close that it was impossible to confine each female to her own. Other specimens were noted with eggs in clusters of 22 to 64.

Whether fertilization of the eggs takes place in the fall or spring is not known. The spermathecae of Hemidactylium were not examined by Kingsbury ('96) when he made his comparative study of these organs in several species of salamanders. In seeking an answer to this question several dissections were made and the following conditions noted: In all females examined ovarian eggs were found in various stages of development. A single ovary from each of several specimens, taken May 30th and killed June 10th, contained from 90 to 100 eggs varying in size from almost microscopic to .5 mm in diameter. The larger eggs were unpigmented, white and opaque; the smaller, clear with an opaque center and confined to the center of the mass. The condition of some of these eggs might be considered evidence that mating takes place in the spring;

and the fact that males and females have been taken from beneath the same log (C. & H. Thompson '12, p. 36) or stone (Moesel '18) at this time of the year points to the same conclusion.

The four-toed salamander has been taken in the spring as early as April 7th (Wright and Allen '13) and this date probably approximately marks the beginning of general release from hibernation (in the latitude of central New York) and the preparation for mating and migration of the females at least, to situations favorable to development of the eggs. All adult specimens taken in the bogs were females, the sex being determined by dissection. As half-grown specimens have also been found in bogs, it is probable that they too perform the seasonal migration.

Developing eggs were kept in sphagnum moss in jars and cans, some of which in turn were surrounded by moss. With three groups of the eggs a female was placed, the others were simply covered by moss. Apparently the attendance of the female made no difference with the development of the eggs as long as the moisture content of the moss approximated conditions in the field. Eggs kept in moss saturated with water became mouldy and many were lost.

Drawings of the earlier development stages were made from specimens placed in 60 to 70 per cent alcohol on successive days; later stages from live embryos selected at longer intervals. Only those stages showing some particular feature of development are considered in this account, although a constant check was kept on all stages. In all stages the envelops of the eggs are represented more or less diagrammatically as the thickness of these envelops varied constantly with their water content.

Eggs

Unlike the eggs of Desmognathus fuscus, Plethodon cinereus and some others, those of Hemidactylium are not stalked but cling together and to the surrounding moss by the adhesiveness of their gelatinous coverings (plate 4, figures 1 and 2).

In size they vary from 2.5 to 3 mm in diameter and are inclosed by two, at least, gelatinous envelops which give them a total diameter of 4.5–5 mm depending to a considerable extent on the amount of moisture present and consequent absorption. The outer of the two distinct envelops is comparatively thin, tough and elastic; the inner, more fluid in its consistency like clear jelly. In some stages of development it was possible to distinguish a thin vitelline membrane closely surrounding the embryo and separating it from the more fluid envelop.

The eggs were very slightly pigmented on one side when found but it is highly probable that when deposited they were less so. The unpigmented parts were given a light tinge of color by the yolk. Deposited as they were in damp moss, it was often necessary to wash the eggs or remove the outer envelop entirely to free them from adhering bits of rubbish.

Development of the Embryo

When found (May 14th) the eggs were well advanced in development, the earliest stage noticed having the medullary folds fully formed though not yet approximated. As early segmentation and gastrulation stages are normally passed through rapidly, the eggs probably had not been deposited longer than 48 to 72 hours before being discovered (plate 6, figure 1). There is no trace of the blastopore although such early disappearance may be considered unusual. Of the series of eggs examined, only one revealed the conditions noted above, the remaining specimens being considerably more advanced. Another specimen taken the same date has the embryo well defined (plate 6, figure 2), with a median longitudinal depressed line marking the union of the medullary folds. Body divisions are not apparent in this stage unless the slight widening of the anterior end of the embryo be considered as defining the limits of the head. About two-thirds of the circumference of the egg is occupied by the encircled embryo in this stage.

May 16th. Definite head and body regions are evident. Back of the head a slight swelling indicates the position of developing tissue for gill and arm buds. In front, the head is slightly free. The egg is considerably elongated but whether from distortion or influence of the embryo is not apparent (plate 6, figure 3).

May 19th. The development of tissue, which barely indicated the position of gill and arm buds in the preceding stage, shows marked increase and with the head comprises fully one-half the mass of the egg. The embryo is folded upon itself, the head, gill and arm regions occupying one hemisphere, the yoke mass the other. A slight narrowing of the head in front and more definite pigmentation give indications of forming eyes and snout (plate 6, figure 4).

May 21st. The eye regions are highly pigmented and the tissues of the developing gill and arm buds greatly increased in thickness. The three primary divisions of the body, head, trunk and tail are now recognizable; the tip of the tail is in contact with the under side of the snout (plate 6, figure 5). In this stage a delicate membrane, surrounding the embryo, separates it from the jellylike envelop.

May 25th. The embryo shows but little advancement in this period although it is possible that the specimen selected does not represent the normal development. A slightly more pronounced constriction back of the gill and arm region, an increase in the length of the tail and some reduction of the yolk mass is evident (plate 6, figure 6).

May 27th. Buds of the gills and arms defined by lateral depressions; trunk and tail assuming definite shape and yolk mass confined to the region of the lower abdomen. Pigmentation increasing in the eye areas and along the sides of the back and tail.

Drawings of the foregoing stages are from preserved specimens; those which follow were made from living embryos.

June 2d. Length of embryo, 7.3 mm (plate 7, figure 2).

The embryos in this stage are active and revolve freely on their long axes within the gelatinous envelops. The pupils of the eyes are developed; the gill and arm buds are of considerable size. In the specimen figured there are three gill buds on the right side, each separate, on the left but two and these coalesced. The gill slits are still imperforate. Pigment distributed in small flecks on the dorsum.

June 4th. Length 9.4 mm (plate 7, figure 3).

There is a marked development of the gills, the longest equal in length to the head. The fringed condition of the fully developed gills is here presaged by shallow scallopings of the margins. The gill slits now perforate; circulation evident in the gills and along the venter. Pigment spots coalescing more or less giving a decided color pattern to the back and sides. Body behind the head compressed; the posterior two-thirds of the trunk and tail distinctly keeled above, the tail also keeled below. Arms half as long as the head, legs indicated by slight swellings at the base of the tail.

June 6th. Length 12.6 mm (plate 7, figure 4).

Gills fully developed, the fingers of the hand partly so. Legs represented by mere swellings in the preceding stage, now half as long as the arms and notched at their extremities. Of the total length of the body, the tail occupies two-fifths. Trunk above keeled almost to the head; the tail keeled above and to the origin of the legs below. General color and pattern pickerel-like. The flecks of yellowish green and orange pigment originating among those of light and dark grey, by spreading and uniting give a mottled appearance to the sides. On each side of the middle line of the back and tail alternating spots of light and dark gray; the light spot of one side opposite the dark of the other.

June 12th. Length, 13.8 mm (plate 7, figure 5)

Larvae free from gelatinous envelops of eggs. No marked changes except in development of fingers and a slight increase in size. Color pattern slightly modified by coalescence of spots on the back of trunk and tail. The figure is of interest particularly because it shows the extremely compressed, wedge-shaped body.

June 19th. Length 15 mm (plate 7, figure 6).

Gills about half their original length; arms and hands fully developed, the second and third fingers proportionally longer than in the adult. Legs with middle joint free, feet with three toes. Body and tail robust and taking on adult proportions. Center line of back with a series of light gray spots diminishing from before backward and bordered by darker gray, the result of fusion of the alternating spots developed in a previous stage.

June 20th. The single specimen showing reduction of gills, found dead on this date. Attempts to secure additional specimens to complete the series of development stages and show final reduction of the gills were unsuccessful. The sphagnum of the bogs bordering Featherstone lake (near Mariahville, N. Y.) was examined and search made in the thick moss growing about the bases of stumps on the edge of a small hill-top pond, near Ballston lake, New York, but without results.

The amount of yolk in the eggs of Hemidactylium is proportionally smaller than that found in P. cinereus or D. fuscus. In other words, the developing embryos of Hemidactylium have greater bulk compared to the mass of the yolk than is the case in the other species mentioned. In that stage of development of D. fuscus in which arm and gill buds are evident from surface views, the embryo is of relatively small size and encircles the egg (Hilton '09, plate 4, figures 47-48). Practically the same is true of P. cinereus. In Hemidactylium, however, by the time the gill and arm buds are well formed, the yolk mass is confined to the abdominal region of the embryo and greatly diminished; even at an earlier stage considerable reduction of yolk is evident (plate 6, figures 5-6; plate 7, figure 1). The condition of Hemidactylium is perhaps nearer that found in Eurycea (Spelerpes) bislineata whose eggs are deposited in water (Wilder '99).

Early absorption of the yolk presupposes ability in the young larvae to take food independently soon after leaving the egg; but specimens observed, although capable of considerable movement appeared entirely unfitted to capture insects or take solid food. The undeveloped condition of the limbs at the time of hatching gives evidence of the helpless condition of the larvae, particularly when they are not in an aquatic environment. Inez W. Wilder ('13) found newly hatched larvae of D. fuscus very active and able to crawl about; certainly the young of Hemidactylium are incapable of doing this when reared under laboratory conditions. The aquatic larval period of D. fuscus perhaps necessitated the early full development of limbs to enable them to reach the water. Conversely, the absence of an aquatic condition in Hemidactylium may account for the lack of such development although the necessity of being able to capture food remains.

Pigmentation of the integument, as observed in the development of Hemidactylium, has three distinct phases. The earliest indication of color appears as thin wash of pigment more or less regularly distributed. In the second stage the pigment is in irregular flecks confined mostly to the dorsal surface of the body. By spreading and uniting the color pattern is developed in the third stage.

The length of time the gills are retained in larvae reared under artificial conditions depends, to a considerable extent, upon the moisture content of the moss in which they are kept. To determine if possible the influence on development of such factors as light and moisture, some experiments were conducted along the following lines: In some specimens taken May 30th the embryos were supplied with fully developed fringed gills, but still inclosed, June 12th, within the gelatinous envelops. Of these eggs, two lots of about a dozen each were placed in glass jars containing sphagnum moss, supported by a wire screen placed an inch above the bottom of the jar. Water in the jar insured a constant humid condition without being in contact with the moss.

On June 19th larvae were found free in the moss and adhering to the sides of the jars. On June 21st, four specimens in jar 1 and three in jar 2 were found in the water in the bottom of the jars having worked their way through two and one-half inches of moss. Of these seven specimens, but one was alive. On June 23d the remaining specimens died without showing the slightest reduction of gills.

The fact that some larvae worked their way through the moss and into the water probably has no significance. Several artificial conditions imposed on the specimens used in the experiments have no counterpart in nature. (1) To reach the water level in bogs, the larvae would have to burrow through 5 or 6 inches of moss. (2) The burrowing of the specimens kept in glass jars may have been induced through efforts to escape too much light. (3) The moss in the jars was loosely placed and permitted easy access to the water. Finally, the fact that all but one of the specimens were dead when found is in itself evidence that the occurrence was accidental.

The original lot of eggs from which development stages were taken was placed in a glass jar with a perforated top, the whole being kept most of the time surrounded by moss, in a large can. The moss in this jar was damp but not saturated. On June 6th gills were fully developed. Removal of dead individuals and those representing stages of development reduced the original number to three specimens, which on June 12th escaped from the egg envelops. To hasten reduction of gills one of these was placed in moss only sufficiently damp to prevent drying of the specimen. One week later, June 19th, the gills on this specimen were shortened to half their original length.

To recapitulate: Larvae taken May 30th, with gills fully developed and kept in moss saturated with water, left the eggs June 19th and retained the gills without apparent reduction until June 23d, when they died. The young then were retained 20 days in the egg with gills fully developed. Larvae of the original lot of eggs arrived at the gill stage June 6th, escaped from the eggs June 12th and, in the one specimen that survived, considerable reduction was evident June 19th. Specimens with gills in this case, remained within the egg only 6 days.

Thirty days were required to complete the development of larvae in the eggs if, as estimated, they had been deposited 3 days before being discovered. In one specimen the gills were reduced to half their original size in 7 days more. If this be considered a normal reduction, then complete loss of the gills might be accomplished in an additional week or two and the total length of time required for development and transformation be limited to a period of about 5 weeks. The fact that the female found with eggs May 27th had disappeared with her brood some time before June 30th affords some evidence that the whole period of transformation may be accomplished within the limits estimated. The length of time, however, probably varies considerably, as indicated by the retention of gills in larvae kept in saturated moss.

The period of egg-transformation of common species in the east is considerably longer than that estimated for Hemidactylium, as may be seen from the following data taken from the Field Note Book of Fishes, Amphibians, Reptiles and Mammals by A. H. Wright and A. A. Allen:

Spotted salamander, Ambystoma maculatum (Shaw) Egg-transformation 4–6 months
Red-backed salamander, Plethodon cinereus (Green) 2.5–3 months
Purple salamander, Grinophilus porphyriticus (Green) Possibly 2 or more years
Two-lined salamander, Eurycea bislineata (Green) Possibly 2 years
Newt, Notophthalmus viridescens (Raf) 4–8 months

In the case of D. fuscus, Wilder estimated the probable duration of incubation alone to be 5 weeks, and the aquatic larval period, during which the gills are retained, to extend over an additional period of 9 to 10 months.

The chief points of interest in the life history of the four-toed salamander may perhaps be profitably summarized: Adults of both sexes are strictly terrestrial during the greater part of the year. In the latitude of central New York release from hibernation occurs in April and it is probable that pairing of the sexes takes place soon after. During the latter part of April or early May the female, at least, migrates to situations suitable for ovulation and after depositing the eggs remains with them. The period of incubation is variable depending on conditions but doubtless limited to 30 or 40 days. From the scant evidence of observations on a single individual it may be that transformation is accomplished in an additional period of 10 to 20 days. The adult size is probably not reached until the end of the year following that of transformation. Migration to terrestrial situations from the bogs must occur in summer or early fall.

The large number of eggs deposited, their intimate relation to sources of moisture and early absorption of the yolk, indicate recent adaptation to terrestrial life.

Acknowledgments

I am particularly indebted to Dr A. H. Wright of the department of zoology, Cornell University, for kindly interest and suggestions, many notes and personal observations on the four-toed salamander and for identification of plants in the field; to Prof. C. R. Crosby of Cornell for photographs here reproduced, all of which were taken under adverse conditions; and to Miss Julia Moesel, who kindly loaned me her account of the species, containing many records and observations.

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EXPLANATION OF PLATES

Plate 1

Fig. 1 General view of Mud pond and surroundings from the south.

Fig. 2 Southwest side of Mud pond with its bordering growths of shrubs, herbs and sphagnum; the typical habitat of Hemidactylium during deposition and incubation of the eggs.

Plate 1

1

2

Plate 2

Fig. 1 Clumps of red-osier dogwood, hoary alder and shad bush at the bases of which, in the moss, the eggs of Hemidactylium are buried Arrow indicates position of the first lot of eggs found.

Fig. 2 Mass of sphagnum moss opened to expose the eggs of Hemidactylium, which are just below the finger tips of the extended hand.

Plate 2

1

2

Plate 3

Fig. 1 Adult female Hemidactylium scutatum, showing typical coloration of the back and sides, the basal constriction of the tail and rudimentary condition of the inner and outer fingers and toes. Actual length of specimen 65 mm.

Fig. 2 Adult female, another specimen, showing basal constriction of the tail which marks the line of separation of the skin in autotomy, and the less-defined depressed line just anterior, the place of detachment of muscles and vertebrae. In this specimen the tail is widest at a point about one-third of its length back of the constriction. The dorsal extensions of the costal furrows meet the median groove at an acute angle. Actual length 73 mm.

Fig. 3 Adult female showing typical coloration of the underparts, the prominent gular fold and the basal constriction of the tail. The length and thickness of the tail is proportionately less than in the specimen (figure 2) figured beside it. Actual length of specimen 62.5 mm.

Plate 3

1

2

3

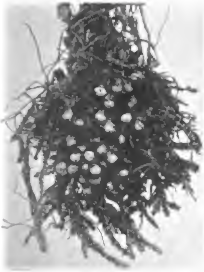
Plate 4

Fig. 1 Eggs of Hemidactylium scutatum, natural size, clinging together and to moss by the adhesiveness of their gelatinous envelops. Photographed with a horizontal camera, the moss being suspended before it.

Fig. 2 A few of the eggs shown in figure 1 enlarged to show gelatinous envelops and the manner in which the outer envelops fuse when the eggs are in contact

Fig. 3 Dead female, Hemidactylium scutatum, posed on her eggs. The eggs are here considerably more scattered than when found. The basal constriction, gular and dorsal folds are evident.

Plate ~~5~~ 4



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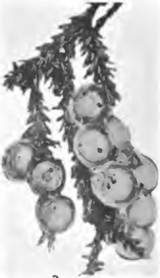

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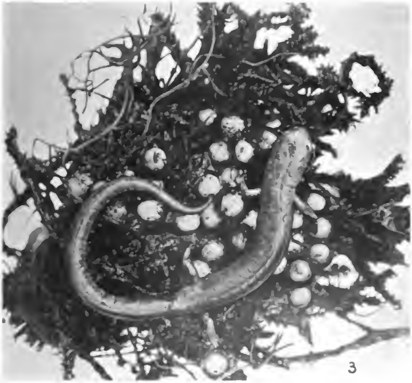

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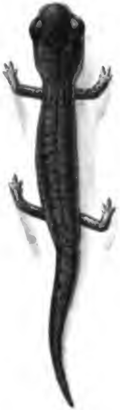
Plate 5

Fig. 1 Half-grown specimen of Hemidactylium scutatum, exhibiting in its proportions and coloration some of the characters of P. cinereus and indicating the close relation to and derivation from Plethodon. Actual length, 30.4 mm.

Fig. 2 Venter of specimen (figure 1) showing aberrant coloration. The tendency of the pigment spots to coalesce, as here indicated, would if carried farther entirely obliterate the typical coloration of the under sides and give the uniform appearance found in P. cinereus.

Fig. 3 Hemidactylium regenerating the tail. The new stub is at first devoid of pigment but later acquires practically normal coloration. Actual length of specimen, 22 mm.

Plate 5



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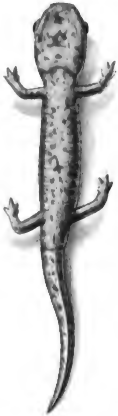

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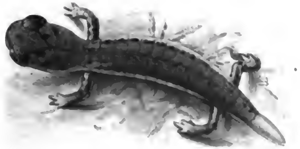

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Plate 6

Development stages of Hemidactylium scutatum Schlegel

Fig. 1 Medullary folds well formed but nowhere approximated. The earliest stage of development observed in group of eggs taken May 14th.

Fig. 2 Embryo defined on the yolk. Union of medullary folds marked by median depressed line. Same date as specimen in figure 1 but much more advanced in development.

Fig. 3 Segregation of tissue giving indication of position, form and extent of head, gill and body regions. May 16th.

Fig. 4 Limits of head well defined; gill region with large growth of tissue preliminary to actual development of gill and arm buds Embryo folded upon itself. May 19th.

Fig. 5 Eyes highly pigmented; gill region much thickened and expanded laterally. Three primary divisions of body — head, trunk and tail recognizable. May 21st.

Fig. 6 Embryo slightly more advanced than that in figure 5. Tail distinct from trunk and constriction back of gill region more pronounced. Reduction of yolk mass evident in this and two preceding stages. May 25th.

Plate 6

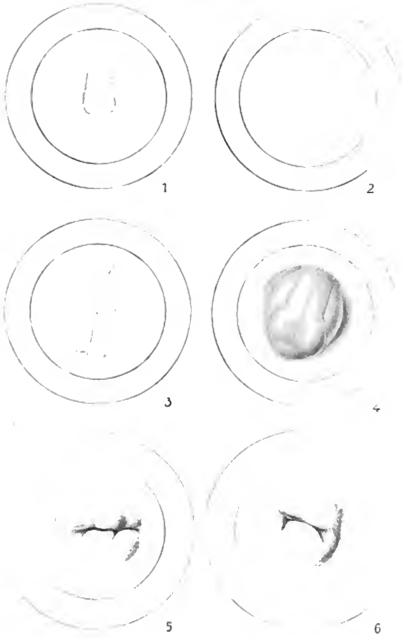


Plate 7

Fig. 1 Gill and arm buds indicated by lateral depressions; head and tail distinct. Yolk mass confined to region of the lower abdomen. May 27th.

Fig. 2 Three gill buds on right side separate, two on left side and coalesced; arm buds well formed. Pigment in irregularly shaped flecks confined to the back of head, trunk and tail. Embryo active within the gelatinous envelops of egg. Eyes prominent with pupils well developed. June 2d. Length of embryo 7.3 mm

Fig. 3 Marked development of the gills with indications of fringes. Body compressed back of the head and yolk confined to anal region of abdomen. Color pattern developing along sides of back and tail. June 4th. Length 9.4 mm.

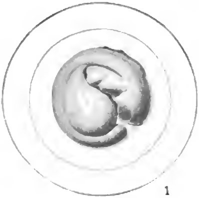
Fig. 4 Gills completely developed and functional; hands with three fingers and legs with indications of developing toes. Color pattern brilliant; light and dark grays predominating with interspersed patches of yellowish green and orange. June 6th. Length 12.6 mm.

Fig. 5 Larva just released from egg envelops. Body and tail compressed and from above, wedge-shaped. Fingers fully developed; toes partly so. Larvae in this stage when placed in water swim freely. June 12th. Length 13.8 mm.

Fig. 6 Reduction of gills 7 days after leaving the egg in larva reared from eggs kept in damp moss. Larva kept in moss saturated with water retained the gills fully developed for 24 days (counting period passed in egg), then died. Adult proportions of body and limbs being acquired in this stage. June 19th. Length 15 mm.

Fig 7 Detail of gill at height of development showing the two rows of fringe. Direction of flow of blood indicated by arrows

Plate 7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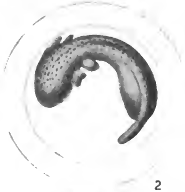
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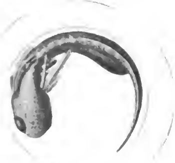
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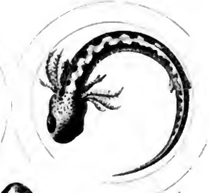
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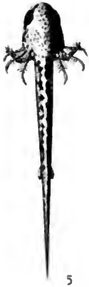
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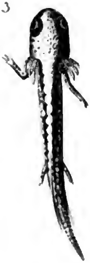
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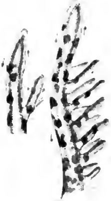
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A. H. Wright

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Vol. 4, No. 1, February, 1923, pp. 26-27

NOTE ON THE NEST AND YOUNG OF THE SMALL BROWN WEASEL

BY SHERMAN C. BISHOP

[*Plate 5*]

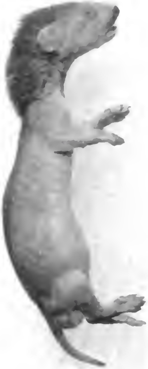
The burrow of a pair of small brown weasels (*Mustela cicognanii cicognanii* Bonaparte) was found May 14, 1921, by the side of a path which runs through a neglected field within the city limits of Albany, New York. The male was killed by boys and reached the State Museum in a mangled condition. The female, whose appearance indicated that she had been nursing young, was trapped the same day but escaped from the box in which she was later confined.

The galleries of the den extended in various directions and covered a considerable area but for the most part were within a foot of the surface of the ground. They were enlarged at intervals and held an accumulation of rubbish and remains of food. On the ground, by the side of the main entrance to the burrows, were the headless remains of two rats. The nest itself, in which were four young, was in a slightly enlarged chamber lined with rat fur, fine grass, and fragments of leaves.

The young, three males and one female, apparently only a few days old and blind, were put in a box with chloroform before being brought to my attention and only one, the female, was alive when discovered. This was photographed immediately.

Notes concerning the habits and young of this weasel, that have come to my attention, make no mention of the peculiar mane-like development of the fur on the top of the head and neck (Plate 5, photo about natural size). Beginning at the line of the eyes, this brush extends back between the ears and tapers to a point between the shoulders. The fur is long, dense, and somewhat darker than that of the back. The tail is proportionally much shorter than in the adult, being only one seventh of the total length. In connection with the distribution of this species, it is of interest to note that the locality at which it was taken comes within the narrow belt of the Upper Austral area of the Hudson Valley. Dr. H. H. T. Jackson of the Biological Survey very kindly verified my identification of the adult male.

State Museum, Albany, New York.



MUSTELA CICOGNANII BONAPARTE. YOUNG FEMALE
Albany, New York, May 14, 1921; natural size

(Bishop: Nest of Brown Weasel.)

A. H. Wright

A Scientific Survey of Turners Lake
Isle-au-Haut, Maine

Made by SHERMAN C. BISHOP and NOAH T. CLARKE

1922

With Special Examinations and Notes by
JOHN M. CLARKE, HERBERT ANT, FRANK W. CLARKE,
BARNARD S. BRONSON, SHERMAN C. BISHOP,
HOMER D. HOUSE, NATHANIEL T. KIDDER,
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J. PERCY MOORE, H. A. PILSBRY,
CHANCEY JUDAY, D. B. YOUNG,
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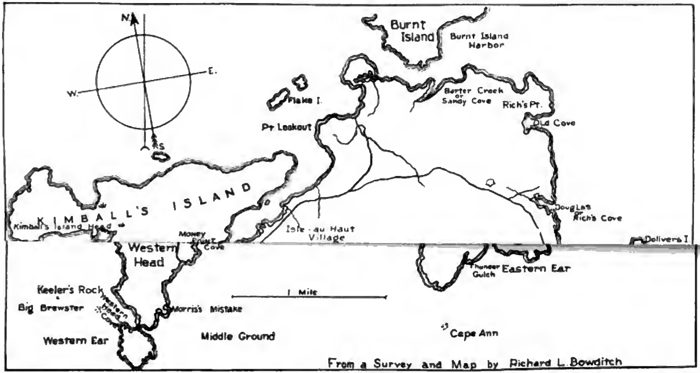


From a Survey and Map by Richard L. Bowditch

Sketch map of Isle-au-Haut reduced from a map made by Richard L. Bowditch. It shows the shape and extent and extent of Turner's Lake and its relation to the coast line and shore outlet. The continuous black lines are roads.

ISLE-AU-HAUT, MAINE, AND ITS LAKE

A NOTICE OF SOME OF THEIR NOTEWORTHY NATURAL FEATURES

Isle-au-Haut is an island far out in East Penobscot Bay, Maine, one of the larger among scores of islands on this coast which are but the tatters of the original shore lands, broken bits of the bones of Maine left on the field after the long battle between sea and land and glacial ice. Isle-au-Haut was discovered and named by Champlain in 1604, although Champlain knew his own language better than to call the island by its present designation. To him it was Isle Haute. Today the name is the survivor of various transmogrifications which have come about through contact with the English who have ever had a genius for disjointing the significance of French place names. For generations of English settlement it was the Isle of Holt, the Great Isle of Holt, associated in the early records of the State of Maine with the Little Isle of Holt, now known as Kimball Island, close upon the northwest shoulder of Isle-au-Haut.

The island has a greatest length of 11.4 miles and a greatest width of 5 miles and its northern end is surrounded by the lesser islands of the archipelago to which it belongs. As a small continental island it shows general features of structure and physiography common to its neighbors and the mainland, but there are certain details of special interest which have been created by its insulation and its individual history.

GEOLOGY

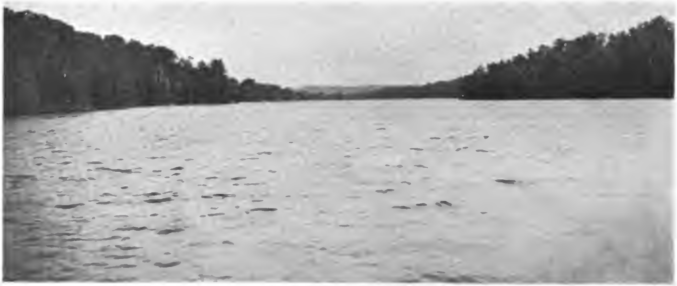
The island has a basic rock structure and surface conformation which are in essential harmony with those of other islands and of the adjoining continent. Its greatest length, northeast-southeast, is determined by the direction of the folded crystalline rocks which makes its axis, Mt. Champlain, whose highest summit at the north attains an elevation of 500 feet. This fold or complex of folds is an index to the direction of all the other more or less concealed and involved folds which constitute the rock foundation of the island. These rocks are for the most part heavily hornblendic gneisses and schists with plenty of diabase intrusions and frequent granite injections. The folds are pre-appalachian and are a part of the fundamental directive series of folds on which the true Appalachian folds of the paleozoic rocks have adjusted themselves. Just where this series is to be fitted into the subdivisions generally recognized as composing the Pre-cambrian is uncertain, but the rocks are obviously of a later term, as among these are stratified quartzites still retaining the cross-bedding of the original beach-sand composing them. The island rocks have been thoroughly glaciated and ice scratches are to be seen from the shore line to the summit of the hills, wherever the composition of the rocks has enabled them to hold against the weathering. This is not often as most of the rocks yield easily to decomposition and it is chiefly on the diabase dikes and hard hornblendic schists that such scratches are retained. The level of the island above the sea has changed in comparatively late times. The "Thoroughfare" which separates Isle-au-Haut from Kimball Island at the northwest, is at full tide open to craft of slight draft, but at low water it is completely choked by broad mussel banks. An extension of these banks has been found well inland along the filled rock trough at the north, lying at a depth that indicates considerable elevation above the present sea line. Evidences of such slight upward movements are to be seen in the generally rounded contour of the rock shores at the east and west. At the south the steeper cliffs, many of which are conspicuous, seem to owe their origin less to any change in the elevation of the land than to the attacks from the open Atlantic against a rock wall weakened by cross folds and joints.

The ice sheet and its consequent debris are doubtless responsible for much obstructed drainage which has produced swampy areas over the uplands, and to that agency we must ascribe the apparent overdeepening or scouring of the rock valley at the east, in which arises the extraordinary lake which it is the purpose of this publication to describe:— Turner's Lake; the name stands for one of the oldest families on the island, and to those who are wont to resort to the place on summer days it is still reminiscent of the times when the self-reliant islanders, depending upon the resources of the fishing, leaned less heavily than today upon contacts with the world outside.

It is not quite certain to the writer whether this lake lies in a fault valley parallel with the crystalline rock folds, or is a cleaned-out synclinal or a glacial trough. Its shore is bounded by low rock outcrops, but they are not sufficiently different in inclination or composition to determine this point. However, the following are the salient introductory descriptive features of this little lacustrine basin: It is 1.2 miles long, 1/10 mile wide, straight, and almost due north and south; its north end is 700 yards from the Atlantic Ocean at the east, the boundary between lake and sea being a rock ledge 20 to 40 feet high; at the south it is 150 yards from the sea into which

Eastern Head harbor from the Sea

Turner's Lake looking north from boat landing.



Turner's Lake, looking south.

it discharges by a narrow and choked outlet running through a constricted rock channel into a mass of beach boulders and gravels thrown up by the sea, and at low tide the fresh water discharge is practically subterranean, as it passes through the beach boulders and its outflow can be seen to best advantage from the sea itself. The sea, however, has not been observed to rise high enough to cover the beach boulders and find its way inward through the basin of the lake itself. The greatest depth of the lake is about 40 feet below sea level. Its greatest actual depth is 56 feet; its average elevation above the sea is 10 feet; its only known inlet is a little stream from the west flowing out of swampland of the Mt. Champlain ledge. The lake has no tide, periodic rise and flow, and as the visible inflow is much less than the visible outflow, it would seem necessary to infer that it is fed by ground water springs at the bottom.

The biological survey of this lake and the gathering of the material on which the following biological and chemical notes are based were carried out by Sherman C. Bishop and Noah T. Clarke of the State Museum during the month of September, 1922. The appreciative interest of Mrs. Mary Clark Thompson has made the work possible.

CHEMISTRY OF THE LAKE WATERS

The water of Turners Lake is notable to the eye for its amberine tints and to the touch for its obvious and velvety softness. There follow herewith analyses of these waters based upon samples taken with all reasonable care from the surface and from the bottom. The analyses have been made by Herbert Ant, Chemist to the Division of Saratoga Springs, New York State Conservation Commission, whose experience in water analyses has been very extensive. Mr. Ant also has given his construction of the actual combinations of the solids in the water.

Dr. Frank Wigglesworth Clarke of the United States Geological Survey, whose repute as a geochemist is of the highest rank, has at my request expressed his judgment upon possible combinations in the water. Finally, Bernard S. Bronson, Professor of Chemistry at the New York State College for Teachers, has contributed a very notable expression as to this matter.

JOHN M. CLARKE

Surface Water

Saratoga Springs, N. Y., *Nov. 14, 1922*

The following are the results of the mineral analyses of the last sample of water which you sent to me. There has been a slight delay in giving you the results, owing to the fact that I was on my vacation:

Parts Per Million

Ions and Radicles		Theoretical Combinations	
SiO_2 silica	2.20	Silica	2.20
Cl chlorine	27.27	Sodium chloride	44.96
Ca calcium	4.00	Calcium carbonate	10.00
Mg magnesium	2.53	Magnesium carbonate	8.77
Na sodium	17.69	Iron and aluminum oxides	21.00
K potassium	4.01		
Fe_2O_3 plus Al_2O_3 iron and aluminum oxides	21.00	Potassium plus organic matter	24.04
CO_3 carbonate radicle	12.24		
Organic matter	20.03	Total solids	110.97

You will note that the water is quite similar to the next sample, with the exception of the organic matter, potash and iron content. The iron is considerably higher in this sample than in the other, while there is a great reduction in the amount of potash and organic matter which would tend to verify my arguments on the first sample — that the potash is in combination with the organic matter with the water. It would seem that the iron content of this water is derived from some sort of iron secreting bacteria. The sample of water received had a decidedly fishy odor. There was an entire absence of the putrid odor that accompanied the other sample.

Yours very truly,

Herbert Ant,

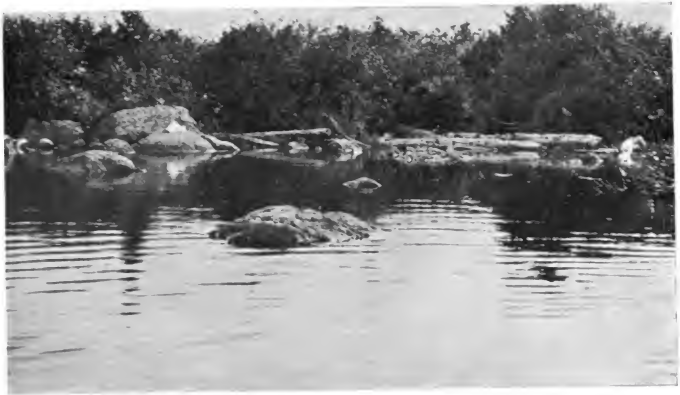
Chemist

Bottom Water

Saratoga Spa, *Oct. 9, 1922*

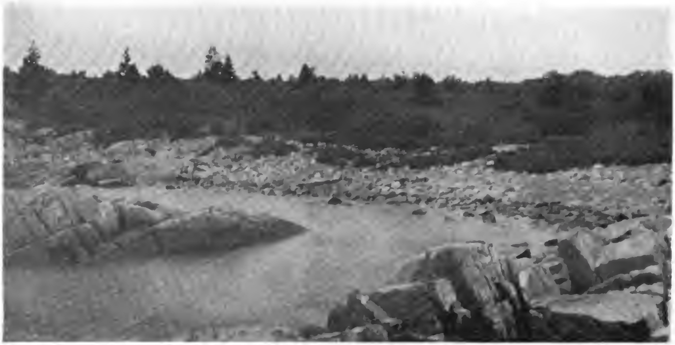
The following are results of the analysis of the sample of water received by me on October 2, 1922. The results are given in Parts per Million and as ions and radicles. I have endeavored to give a theoretical combination of the ions; but this is somewhat difficult on account of the very high organic content.

South end of lake, looking toward outlet.



Turner's Lake near the outlet.

2



The outlet at the south end of the lake. The water comes through the boulder barriers and flows into the sea at and above high tide.

Ions and Radicles	
SiO silica	4.40
Cl chlorine	24.00
Na sodium	15.52
K potassium	11.20
Ca calcium	4.14
Mg magnesium	2.92
CO carbonate	13.41
FeO-AlO iron and alumina	5.20
Organic matter	72.59
	153.38

Theoretical Combinations	
Silica	4.40
Sodium chloride	39.45
Calcium carbonate	10.35
Magnesium carbonate.	11.12
Iron and aluminum oxides	5.20
Potassium combined with organic matter.	83.79

In making the theoretical combinations I found that there is not enough mineral matter with which to combine the potassium, so that it must be associated with the organic matter.

The water has a very disagreeable odor, an intense brown color and a heavy sediment. I have never encountered a water anywhere similar to this one and I am wondering if the peculiarity is not due to an unclean jug in which cider or some such liquid had been kept. (see p.)

Very truly yours,
HERBERT ANT,
Chemist.

DEPARTMENT OF THE INTERIOR, UNITED STATES GEOLOGICAL SURVEY, WASHINGTON, NOVEMBER 23, 1922

DIVISION OF CHEMICAL AND PHYSICAL RESEARCHES

The two water analyses which you sent me are not easy to interpret, for I do not know how the samples were collected and shipped, nor how the analyses were made and calculated. The sodium and chlorine are doubtless of oceanic origin, in part if not wholly cyclic, that is, brought down in rain over the drainage basin of the lake. The other constituents, except the organic matter, came from the feldspars and ferromagnesian minerals of the granite. The apparent excess of potassium may be held in equilibrium with silica, although the balance between the two is not very close. How much of the trouble is due to analytical errors, which are never wholly avoidable, I will not attempt to say. I doubt, however, that any organic salt of potassium is present, but it is possible that some of the needed silica, itself collodial, may have been retained by the collodial organic matter. That might account for the discrepancy.

F. W. CLARKE.

NEW YORK STATE COLLEGE FOR TEACHERS

ALBANY, *June* 14, 1923

The correct interpretation of the analyses of water submitted is very difficult if not impossible.

Time has not been available for the consideration of this problem in all its phases. Accepting the analyses as given it would seem to me that other theoretical combinations than those presented would be more consistent.

In both analyses I should assume that the potassium is held in theoretical combination with the silica and the alumina. In the analysis of the surface water therefore the theoretical combinations might be:

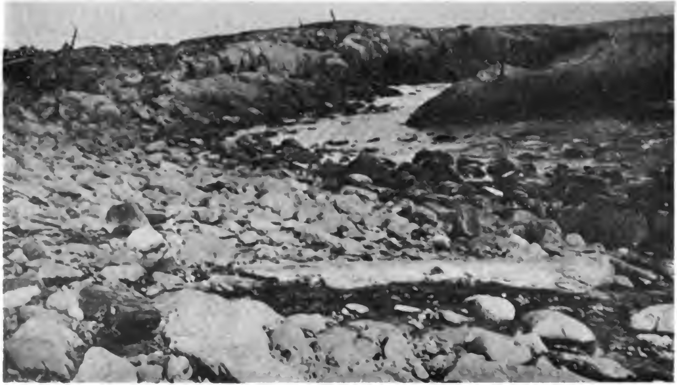
K_2SiO_3	5.64
$K_2Al_2O_4$	2.75
$NaCl$	44.94
$CaCO_3$	10.00
$MgCO_3$	8.77
Al_2O_3, Fe_2O_3	19.49
Organic	20.03

The iron and the aluminum could very well be held in solution in the form of colloidal hydrates. This water would be alkaline but with an uncalculated P_H value.

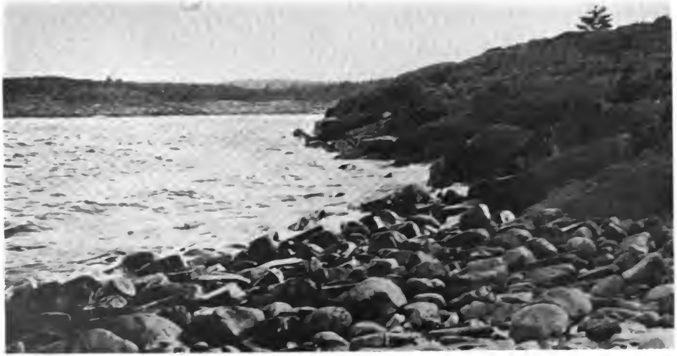
Similar theoretical combinations might be made from the report of the bottom water. The hydrogen ion concentrations however differ inexplicably. Determination of the P_H values might have helped considerably in formulating a consistent hypothesis.

Combinations, such as those given, relieve the necessity of imagining so great an amount of the potassium in combination with the organic matter. This hypothesis to me seems doubtful.

K_2SiO_3	11.28
$K_2Al_2O_4$	4.74
Fe_2O_3	2.60
K_2O	3.90



Outlet at the sea beach. The lake waters come down through the mass of pebbles in the foreground.



Outlet of lake looking from the sea.

Other combinations as given, except that the potassium in combination with organic matter will be correspondingly decreased.

BARNARD S. BRONSON.

At the south end of the lake flocks of herring gulls from outside are, on summer days, ever cavorting in the soft waters, in their enjoyment of a fresh-water bath. It seems reasonable to suppose that some part of the potassium in the water may be due to their presence. J. M. C.

THE BIOLOGY OF TURNER'S LAKE.

SHERMAN C. BISHOP

This narrow strip of water lies in a spoon of the island like an amber bar in a setting of green, gold and white. The cedars, maples and birches, banked steeply at the water's edge, thinning somewhat, climb to the summit of the ridges that lie to the west and form the backbone of the island. Eastward a lower ridge follows the line of the lake and carries the road which traverses the woods at the north to Head Harbor at the southeast. At the south, the rocky barrier that pockets the slow waters beats back an encroaching alder swamp following the short outlet up from the sea; northward a gentle gravel slope, once cleared, brings to seed a crop of lusty weeds.

Halfway down the west side, the rivulet Bull brook creeps in after a noisy journey over a rough bed, from its source in the sphagnum bogs on the axial ridge. The outlet leaves the southeast end in a tangle of undergrowth and stranded, rotting logs grown over with moss and ferns.

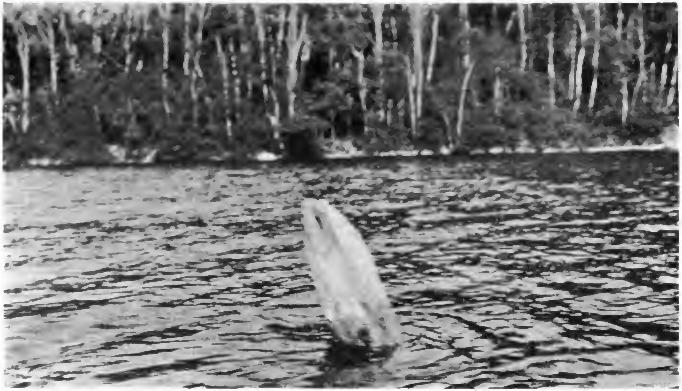
The narrow trough filled by the lake seems to be a continuation of the swampy valley lying to the north which is held back at a higher line by the gravel slope which separates them. The lake itself has a length of only a little less than a mile and a quarter and an extreme width of about two hundred and twenty yards. At the north end where surface wash from the slope above has built up a sandy bottom, the water is shallow but south of this, in the mid-line of the lake, the depth regularly increases for five hundred yards to the maximum of fifty-six feet. South of th's point for a thousand yards, the water gradually shallows marking a gentle rise of bottom leading to a rocky cross-ridge whose highest point is some twenty feet below the surface. The position of this drowned ridge is marked by a vertical white cedar log which rears a broken trunk a foot or two above the surface. The depth again increases to forty-eight feet midway between the tree and the boat landing at the south end of the lake. The surface of the lake is only a few feet above tide; its bottom fully forty feet below.

Along the west shore in stretches of comparatively shallow water and near the outlet, bedrock reaches the surface; at these places and along both banks where the waves have cut away the turf, the rocks are sometimes pitted as if by action of some strong solvent. The water itself is amber except in the shallows because rich in organic materials derived both from the sphagnum bogs that feed the inlet and from decaying vegetation. Huge cedar trunks that dwarf the living trees of the shores sprawl over the bottom, their skeleton arms hairy with trailing filaments of algae and blotched by livid green of sponges.

In its organic life the lake is perhaps more notable for its lack of many common plants and animals than for the presence of unusual forms. No cat-tails are there to hide the floating nest of the grebe and invite the marsh wren, nor duckweed greening the surface in the quiet coves; no waving ribbons of eelgrass nor rough-stemmed stoneworts or pondweeds common to muddy bottoms. In the shallow areas near either end of the pond the waterlilies float their broad fans or, caught by the breeze, roll them in glistening cylinders. Here too the floatingheart dangles its spur-like roots and rides at anchor. No pickerel weed blues the shores with its stiff pikes or arrowhead brandishing broad blades, but in their places a few burweeds and sedges, loosestrife and woolgrass. The leathery mantle of *Nostoc* blankets the sandy bottom at the north, punctured here and there by some stiff stemmed rush; and in scattered patches the pipewort spreads its myriad-pointed stars.

In summer and autumn the birds of the lake are largely borrowed from the sea. Herring gulls gather almost daily in the south shallows to cleanse themselves of the sea-rime in the soft waters; they drop urchins on the rocks and leave the shells of crabs to bleach in the crevices; or a sea duck varies his diet by a cruise over the shallows; ospreys visit the pond but leave the small prey to the kingfishers.

No turtles were found in the lake nor were they reported by those who fished its waters; frogs are infrequent, for only three were seen and those near the swamp from which they may have come. Even the fish are few in kinds though our nets and traps yielded a proper quota. Eels abound but they are mostly small, and numerous sticklebacks found our traps in twenty feet of water; these and the smelt and the introduced salmon were all that were taken.



The Arbor-vitae stump projecting above the water near the south end. Total length 26 feet.

View looking south showing the Arbor-vitae stump.

The bottom rubbish near the shore, usually so prolific of life is here almost barren; only a few snails, small and thin of shell, and caddisworms tumbling their cases over the stones that hid the may-fly nymphs. Leeches abound and are easily collected if one wades barefooted. On the surface water beetles (gyrinids) and water-striders occur sparingly. The open water offers the richest catch if the net is of fine mesh. Myriads of minute crustaceans (Entomostraca) of several species, and water mites are present, the latter the most conspicuous organisms of the lake at a depth of thirty feet. These small mites, seemingly so ill adapted to aquatic life in spite of their specialized swimming devices, are surprisingly abundant, every haul of the net bringing them in by hundreds.

Insects that pass the larval stage in water are strongly represented in the air above the lake by the mosquitoes; but these may well have bred in the swamps nearby rather than in the lake itself; for larvae were absent in the water that half-filled a stranded boat; neither were larval exuviae to be found in the shore litter washed up in narrow windrows at the north end. If indeed mosquitoes do not breed in the lake, perhaps a clue to their control may be found in the analysis of the water. Tandem-flying dragon flies appeared from time to time and others flying single, dipping their tails between the lily pads and hawking the open swarms of *Plecia* that passed in sluggish, weaving flight over the water.

The white cedar trunk which tops the buried ridge in the lake is a watermark of considerable note for it was standing up to the wind and above the waves when the earliest settlers came to the island. It still serves as a convenient mark for hunters who wish to prove the merits of their rifles. Anchored by its root it stands almost erect in 4 fathoms of water. Whence this great tree came is a problem for some ingenious brain. That it long antedates the present forest conditions is obvious, for there are no such great cedars left on the island. There seem to be no currents in the lake that could have transported it erect from the shore, nor are there movements of ice in this little lake which would be at all competent to float and drop this heavy load into its present attitude. For some hundreds of years, no doubt, it has resisted the decomposition by the water whose singular chemical ingredients may have helped in its preservation. This arbor vitae tree stands forth as one of the many mysterious things that enter into the make-up of this unusual body of water. Long dead, the old stub each year greens into life with an alien verdure of freshwater sponge worn as a belt about four feet below the surface. The sponge itself is worthy of record for imbedded in its tissues and crawling about over the surface are the micro-caddisfly larvae which clothe themselves in mantles of silk and the delicate crystal spicules borrowed from the host.

The dominant trees of the shores are the white and yellow birches, maples (*Acer spicatum*), and the arbor vitae; but scattered among them are balsam and spruce, poplar and mountain ash, with thickets of alders in the wet spots. Near the outlet and along the southwest bank, the withe-rod (*Viburnum cassinoides*) grows and with it the mountain holly (*Nemopanthus mucronata.*)

The plants and animals named in the lists that follow are the common obvious forms present in the lake and along its shores found during September, 1922. Collections made at other seasons of the year would doubtless augment the various lists, particularly that of aquatic insects. Enough evidence was collected however to show that the character of the water inhibits the growth of many organisms and that further study might throw some light on problems of soil and water preference.

Considerable time was spent in taking soundings to determine the topography of the lake bottom; the results are shown on the accompanying sketch map. Samples of water for analysis were taken with great care at the surface and at a depth of about fifty feet; the latter sample by means of a weighted container from which the stopper was removed and replaced by lines manipulated at the surface.

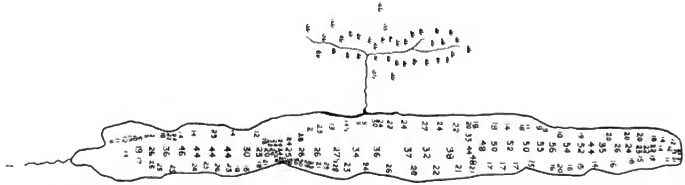
We are greatly indebted to the various specialists who have identified the materials collected and whose names accompany the lists; and to Mr. and Mrs. Ulysses S. Grant for many courtesies and much information concerning the island and its lake.

PLANTS

Determined by Dr. Homer D. House, N. Y. State Botanist; reviewed and checked by Nathaniel T. Kidder whose acquaintance with the flora of Isle-au-Haut is intimate.

The majority of the plants listed below are aquatics or, in some cases, plants growing as aquatics that are ordinarily found in drier situations. No attempt was made to collect the species of the bordering woods.

Sparganium americanum Nutt. Bur-reed. This species and the next were found only in scattered patches in shallow water at the south end of the lake and infrequently along the west shore. It is rather common in low grounds from Nova Scotia and Ontario to Iowa, Oklahoma and South Carolina.



Sketch map of Turner's Lake showing the soundings in feet. The direction of the lake is nearly due north-south.

Sparganium minimum Fries. This bur-reed has been recorded in cold, shallow waters from Labrador to Alaska, Oregon and New Jersey. Seven or eight species of bur-reed are known to occur in northeastern North America.

Potamogeton epihydrus Raf. Pondweed. Only a few single plants found at the north end of the lake, all with submerged leaves. Of the thirty or more species and subspecies of *Potamogeton* recorded from the northeastern United States, only one seems to have become established in the lake. Moore[1] found seven species growing in greater or less abundance in Cayuga Lake, New York, and Baker[2] investigating the conditions in Oneida Lake, New York, reported ten.

In ponds and streams, Newfoundland to British Columbia, North Carolina and Iowa.

Leersia oryzoides (L) Sw. Rice Cut-grass. This is the common form found in swamps and along streams from Newfoundland to Oregon, south to Florida and Texas.

Calamagrostis canadensis (Michx.) Beauv. Blue-joint grass. The typical form is found in wet places from Newfoundland to British Columbia, North Carolina, New Mexico and California.

Dulichium arundinaceum (L.) Britton. Occurs in wet places and along borders of ponds from Newfoundland to Ontario, Minnesota, Washington, Texas and Florida.

Scirpus cyperinus var *pelius* Fernald. Wool grass. The variety *pelius* is the common form from Newfoundland to Ontario south to Connecticut, New York and Michigan. In Turner's Lake found in shallow water near outlet.

Carex lurida Wahlenb. Sedge. Swamps and wet meadows from Nova Scotia to Minnesota, Nebraska, Texas and Florida. The only member of the genus found in Turner's Lake.

Eriocaulon septangulare With. Pipewort. Common at both north and south ends of the lake and in patches along the west shore. It is generally distributed from Newfoundland to Ontario, Minnesota, Florida and Texas.

Juncus militaris Bigelow. Rush. Lake margin particularly at south end. Nova Scotia to northern New York and Maryland.

Nymphaea advena var. *variegata* (Engelm.) Fernald. Yellow cow lily. In mud bottomed areas at southwest end of lake and in scattered patches along west shore; a large patch in shallow water at north end. The variety *variegata* is more commonly found in the northeast than the typical *N. advena.*

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[1] Bull. Bur. Fisheries. 1913. 33:261-268

[2] Tech. Pub. No. 9. N. Y. State College of Forestry, 1918, 18:51

Castalia odorata (Ait.) Woodville and Wood. Sweet-scented water lily. Small groups among larger masses of the yellow cow lily. This is the common white water lily of the east. A form having pinkish flowers is said to have been introduced a few years ago but we could find no evidence of its development. Newfoundland to Manitoba, south to Florida, Louisiana and Kansas.

Spiraea latifolia Borkh. Meadowsweet. Growing at the edge of the water. Newfoundland to Saskatchewan, Virginia and Pennsylvania.

Hypericum virginicum L. March St. John's-wort. Common in swamps from Newfoundland to Florida, west of Manitoba, Nebraska and Louisiana.

Lysimachia terrestris (L.) B. S. P. Loosestrife. The loosestrife grows in low grounds from Newfoundland and Hudson Bay, south to Georgia and Arkansas.

Nymphodes lacunosum (Vent.) Fernald. Floating-heart. The floating heart grows at both ends of the lake in moderately deep water. The floating leaves with cluster of like tubers at their bases drag at the ends of a slender stem often several feet in length. It is found from Nova Scotia to Florida and locally westward.

Lobelia Dortmanna L. Water Lobelia. In shallow water at south end of lake. Newfoundland to New Jersey and Pennsylvania and northwestward.

Solidago graminifolia (L.) Salisb. var *Nuttallii* (Greene) Fernald. Grows with its roots in the shallow water at south end of the lake and along the east shore. Distributed from New Brunswick to Saskatchewan, Alberta, Florida, Nebraska and Wyoming.

Aster longifolius Lam. Aster. This species and the next following, grow from the rotting driftwood at the outlet and in the shallows along shore. Found from Labrador and Saskatchewan, northern New England, Ontario to Montana.

Aster novi-belgii L. Aster. Newfoundland to Maine and Georgia, mainly near the coast.

ALGAE

(Identified by Dr. MARSHALL A. HOWE, New York Botanical Garden)

Phormidium Retzii (Ag.) Gomont. In Turner's Lake found growing with patches of *Bryum bimum* Schreb.

Stigonema ocellatum (Dillw.) Thuret. Free floating or attached to submerged twigs and stones.

Oedogonium sp. A few sterile filaments collected from submersed twigs.

Rhizoclonium hieroglyphicum (Ag.) Kütz.

Mougeotia sp. Sterile filaments only collected.

Nostoc Linckia (Roth.) Bornet. Over many square yards of bottom at the north end of the lake, in water that reaches a depth of four or five feet, the gelatinous envelope of this alga forms a continuous blanket which excludes all other plants except a few stiff stemmed rushes.

MOSSES

(Identified by Mrs. N. L. Britton, New York Botanical Garden)

Bryum bimum Schreb. In rounded clumps at the water's edge.

Fontinalis antipyretica L. Water Moss. Grows beneath the surface on rocks and stones at Turner's Lake.

ANIMALS

PORIFERA

(Identified by Professor Frank Smith, University of Illinois)

Fresh Water Sponge

Heteromeyenia ryderi Potts. This sponge was found growing on logs at a depth of four or five feet below the surface. Statoblasts of two species of *Bryozoa* were collected with the sponge material and these have been provisionally identified as belonging to *Cristatella mucedo* Cuvier and *Pectinatella magnifica* Leidy.

HIRUDINEA

(Identified by Dr. J. Percy Moore, University of Pennsylvania)

Leeches

Erpobdella punctata (Leidy) This is a common and widely distributed member of the family, very active and voracious. It will take human blood when given the opportunity.

Holobdella stagnalis (Linn.) Very abundant in the shallow water along shore in Turner's Lake but not usually observed unless the bottom rubbish is disturbed.

MOLLUSCA

(Identified by Dr. H. A. Pilsbry, Academy of Natural Sciences, Philadelphia)

The meagreness of the molluscan fauna of the lake is one of its striking features. Only four species were found and these represented by less than a score of individuals although careful search was made in the rubbish raked from several square yards of bottom at both the south and north ends. This condition may be better appreciated by comparing the results of investigations carried on in some well known inland lakes. Baker[1] found 91 species and varieties in Oneida lake, N. Y. and as many as 16 individuals per unit of 16 square inches. Evermann and Goldsborough[2] without giving particular attention to the group collected 15 species in Chautauqua lake, New York.

In the following species, the shells are all below normal size and unusually thin.

Planorbis antrosus Conrad. This is a common species in the eastern United States and Canada south to New Mexico.

Physa heterostropha Say. Widely distributed in eastern states from Maine to Georgia, west to Michigan and Illinois.

Musculium securis Prime. Common throughout the United States east of the Rocky Mountains.

Pisidium abditum Hald. One of the most widely distributed members of the genus. Occurs in eastern Canada and United States south to South Carolina; also found in California and Honduras.

CRUSTACEA

ENTOMOSTRACA

The Water-Fleas

(Identified by Dr. Chauncey Juday, University of Wisconsin)

The water-fleas are mostly minute forms which occur in great abundance in fresh water ponds, lakes and streams all over the world. In spite of their small size they are of great importance not only as the chief food of many young fishes but of certain larger species, like the white fish, that have specialized devices for straining them out of the water.

In Turner's lake eight species are found, all of which are well known and widely distributed.

Collections were made by means of a conical net of fine silk dragged at the surface and at depths of fifteen and thirty feet.

The species found at the surface:

Diaphanosoma brachyurum (Liévan). This species is common in marshes and in weedy margins of lakes and ponds.

Ceriodaphnia quadrangula (O. F. Müller). Common in all regions among weeds and in deeper waters of lakes.

Bosmina obtusirostris Sars. This is a variable species found in pools and lakes in many regions.

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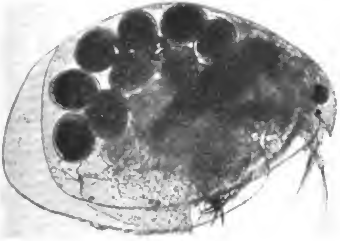
[1] Tech. Pub. 9, N. Y. State College of Forestry, 1918, 18:181

[2] Rept. U. S. Fish Commission for 1901 (1902) p. 175



Eurycercus lamellatus; a water flea with eggs, magnified about 25 diameters.

Polyphemus pediculus (Linné). Common in northern United States in lakes and pools.

Epischura lacustris Forbes. Central and eastern United States in lakes and ponds.

Diaptomus minutus Lilljeborg. Northern United States and north to Greenland and Iceland.

Cyclops viridis var. *americanus* Marsh. This is a widely distributed species in pools and lakes.

The species found at the surface were taken again at a depth of 15 feet with the addition of:

Eurycercus lamellatus (O. F. Müller).

This is the only species of the genus found in America and is common in permanent pools and lakes. The figure is enlarged about 25 diameters and shows a mature female with eggs in the brood chamber on the back.

At a depth of thirty feet were all species found at the surface with the exception of *Polyphemus pediculus* (Linné).

It is perhaps worthy of remark that none of the larger crustaceans were collected in Turner's Lake, although careful search was made in all situations. This is the more remarkable because of the great abundance of the smaller forms.

Eurycercus lamellatus (O. F. Müller). This is one of the commonest and largest of the water-fleas. The dark, round spots are the eggs enclosed in the brood chamber on the back. The large dark area is a mass of food packed in the alimentary canal. Photograph about twenty-five times natural size.

INSECTA

(Identified by D. B. YOUNG, Assistant N. Y. State Entomologist, Professor P. W. CLAASSEN and Dr. W. T. M. FORBES of Cornell University)

Ephemeridae

The May-flies.

No adult May-flies were taken, but a few nymphs belonging to the genus *Rhithrogena* were found under stones near shore.

Odonata

The Dragon-flies

Dragon flies were not uncommon about the lake, particularly the small *Sympetrum vicinum* Hagen. On Sept. 16th a pair of *Aeschna constricta* Say was taken and a few days later a pair of *Somatochlora tenebrosa* Say. These are all common and widely distributed species.

Hemiptera

The Bugs

Arctocorixa calva (Say).

Metrobates hesperius Uhl.

Trichoptera

The Caddis-flies

Stenophylax scabripennis Ramb. The adults of only a single species of caddis-fly were taken but empty cases of two or three distinct types were noted in shallow water. A separate account of caddis-fly larvae found living with the fresh water sponge, is given in another place.

Lepidoptera

Moths, Butterflies etc

Larvae of *Nymphula* (*Parapoynx*) *maculatis* Clemens were commonly found on the under surface of lily leaves, in cases made from fragments of the leaves; in a few instances they were collected in the plankton net drawn at the surface.

Diptera

Flies.

Plecia heteroptera Say. Many found in open swarms over the lake and along the road.

Aedes stimulans Walk. No evidence was found to indicate that mosquitoes were breeding in the lake in spite of the great numbers flying over the water. Lake water in a half sunken boat held no larvae nor were the larval exuviae found in the shore litter or in the plankton net drawn at the surface. It is probable that the majority of the mosquitoes came from the nearby swamps.

Coleoptera

Beetles

Gyrinus borealis Aube.

Dineutes assimilis Aube.

Galerucella nymphaeae (Linn.) Larvae on lily leaves.

ARACHNIDA

Hydracarinae

Water Mites

(Identified by Dr. ROBERT H. WOLCOTT, Lincoln, Neb.)

Unionicola crassipes (Mull.) These mites are exceedingly abundant at a depth of thirty feet but were taken in lesser numbers at the surface and intermediate depths.

Piona inconstans (Wolc.) Both sexes were taken at various depths down to thirty feet.

VERTEBRATES

(Identified by SHERMAN C. BISHOP)

FISHES

Eel, *Anguilla chrisypa* Rafinesque. Very abundant in the pond and usually of small size. Many taken on set lines and in the small traps set for stickle backs.

Nine-spined stickleback, *Pygosteus pungitius* (Linn.) Extremely abundant and taken at all depths down to 20-25 feet. Small, the largest observed only one and three-quarters inches long.

Smelt, *Osmerus mordax* (Mitchill). A few are usually taken each year through the ice near the mouth of the inlet. Two specimens 7½ to 8 inches long were taken on worms in 24 feet of water. Land-locked salmon, *Salmo sebago* Girard. Introduced a few years ago and now apparently established. A few are taken by trolling and still fishing with worms. The larger specimens average about three or four pounds in weight. Two specimens were taken in September, 1922, on worms.

AMPHIBIANS

Ambystoma maculatum (Shaw). Spotted salamander. A single large specimen under a stone at the water's edge.

Rana palustris Le Conte, Pickerel frog. Three recently transformed specimens in shallow water at south end of lake; these may have come from the nearby swamp. Residents of the south end of the island say that frogs are infrequently seen in or about the lake and that the calls are not often heard in the spring.

REPTILES

No specimens were seen in the immediate vicinity of the lake but a small red-bellied snake *Storeria occipito-maculata* (Storer) was found in the road a short distance away and garter snakes (*Thamnophis*) are occasional and the green snake (*Liopeltis*) abundant on the island.

Turtles were not found in the pond nor have they been noticed by those who fished its waters.

SUMMARY

The Isle-au-Haut lake is clearly not the remnant of a fiord. It has no residual inflow nor any indication of prior river erosion. The drainage that keeps it in existence is small and highly obstructed; hence, in some degree no doubt, the lack of a normal circulation of the waters makes them somewhat stagnant and overloaded with organic matter. It is probable that this excess of organic matter has made conditions of living unwholesome to many lacustrine forms of life usual to the lake waters of eastern America. These suggestions, however, still leave many things to be explained, for adaptation is clearly evident in the case of the introduced fish, the salmon, and would hence seem to have been possible for other normal lacustrine species here absent. The boundary of the lake at the south is so obviously barricaded by a rock wall, that one can not ascribe the making of the lake valley to sea action; that is, it seems to have no relation, in origin, to the "goes" elsewhere described as caused by the removal of a joint-bounded rock prism. The tangible explanation of the origin of the lake basin seems now to rest upon the conception of a down-sunken fault bluff of the rocks, bounded and controlled by major fault lines parallel to the axial rock structure of the Island.

J. M. C.

A LIST OF SPIDERS TAKEN ON ISLE-AU-HAUT, JULY TO OCTOBER, 1922, TOGETHER WITH A DESCRIPTION OF A NEW SPECIES

By Sherman C. Bishop

During July, 1922, a considerable number of spiders and phalangids were collected on Isle-au-Haut by Miss Sally Bowditch and Mr. E. Lufkin. A dozen or more additional species were taken by the writer in September of the same year. The list is by no means representative of the spider fauna of the island for in general it includes only the larger and more easily collected species; but it adds something to our knowledge of the distribution of some eastern species and is herewith presented for purposes of record.

Dictynidae

Amaurobius bennetti (Blackwall).

Drassidae

Gnaphosa gigantes Keyserling.
Herpyllus vasifer (Walckenaer).
Zelotes ater (Hentz).

Theridiidae

Steatoda borealis (Hentz).
Theridion topidariorum C. Koch.

Linyphiidae

Drapetisca alteranda Chamberlain.

Argiopidae

Araneus angulatus Clerck.
Araneus marmoreus Clerck.
Araneus nordmanni (Therell).
Araneus patagiatus Clerck.
Araneus sericatus Clerck.
Araneus trifolium (Hentz).
Cyclosa conica (Pallas).
Meta menardi (latroille).
Pachygnatha brevis Keyserling.
Tetragnatha extensa (Linne).

THOMISIDAE

Misumena vatia Clerck.
Thanatus coloradensis Keyserling.
Tibellus oblongus (Walckenaer).

CLUBIONIDAE

Castaneira descripta (Hentz).

AGELENIDAE

Agelena naevia Walckenaer.
Hahnia agilis Keyserling.

LYCOSIDAE

Alopecosa beanii (Emerton).
Lycosa frondicola Emerton.
Pardosa xerampelina (Kyserling).

ATTIDAE

Dendryphantes montanus Emerton.
Dendryphantes purpuratus (Keyserling).
Salticus scenicus (Clerck).

PHALANGIDA

Oligolophus pictus Wood. One specimen, September.

A CADDISFLY GUEST OF THE FRESH-WATER SPONGE

BY SHERMAN C. BISHOP

Some fragments of a fresh-water sponge* collected in September 1922 in Turner's lake, Isle-au-Haut, Maine, and preserved both in alcohol and by drying, were found on examination to contain a considerable number of the larvae and cases of an interesting micro-caddisfly. Some of the cases were wholly enveloped in the sponge tissue, others only partly overgrown, while a few individuals retained their hold on independence by moving about often enough to prevent permanent attachment.

In the construction of the case a silk foundation is used but the external protective material is composed of the transparent sponge spicules laid first in more or less regular transverse rows then apparently stuck on haphazardly or perhaps simply entangled on the surface. The cases are minute, slightly curved and tapering cylinders varying from 2 to 5 or 6 mm in length and greenish in freshly collected material but turning to light brown in preserved specimens. The smaller end, in perfect cases, is sharply constricted and usually free from spicules; the anterior end has a slightly projecting hood (pl. 1, fig. 2.) Only a single case was observed that had served as a pupal chamber and this was provided at each end with a net work of fine silk supporting heavier rings of the same material (pl. 1, fig. 3). The insect had escaped by cutting away the silken barrier until it hung on one side like the lid of a coffee pot.

The larva (pl. 1, fig. 1) itself is slender and almost transparent and lacks the abdominal respiratory filaments; the legs are progressively longer and slimmer from before backwards. The first legs are decidedly heavier than the others and have the femora provided with serrated ridges bordered on each side by stout spines (pl. 1, fig. 4); the tibiae are widened distally and each armed with a single blunt spine and a few hairs; the tarsi, like the femora, bear serrated ridges which may be opposed to those of the femora to form effective grasping organs. The second and third pairs (pl. 1, figs. 5-6) are long enough to extend to the front of the head or beyond and bear many slender spines or hairs

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*1. The sponge has been identified by Prof. Frank Smith as probably *Heteromeyenia ryderi* Potts; positive determination is impossible owing to the lack of gemmules in the young colonies.

Plate 1.

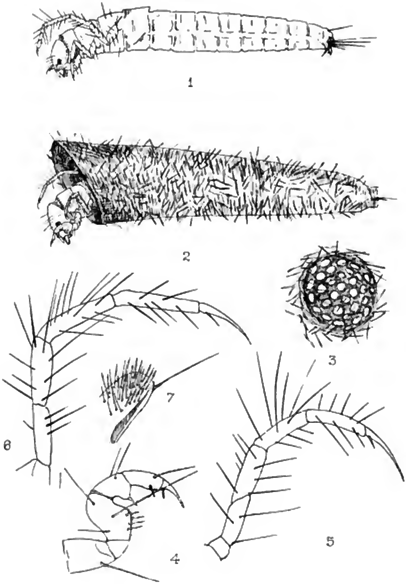
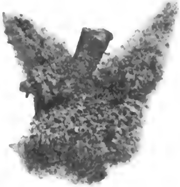


Plate 2.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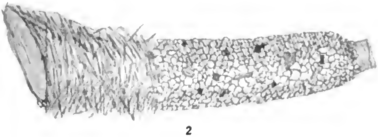
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some of which may perhaps be tactile; the spinose hump on the first abdominal segment (pl. 1, fig. 7) is directed forward and down and backed by a chitinized ridge. The photograph (pl. 2, fig. 1.) shows a small fragment of dried sponge with a larval case attached.

This association is, perhaps, an example of dependent life in its incipiency; for not only do certain individuals maintain their cases free from the growing sponge but one was noticed (pl. 2, fig. 2) which had started to decorate its case with small grains of sand and finished it off with spicules after having grown over half its normal length. If there is any advantage to be derived from the association in the way of food or shelter, it would seem to be a one-sided affair with the caddisfly on the long end of the bargain. When the case is stationary, the sponge probably reacts to it as it would toward any alien bit of rubbish and proceeds to grow around and over it; when the larva continues active, the sponge tolerates it as a necessary evil along with other similar uninvited guests like the spongilla flies, *Climacia* and *Sisyra*. But any temporary advantage is probably offset in the long run by the restrictions placed not only on the movements of individuals but by the limitations imposed by the distribution of the sponge itself.

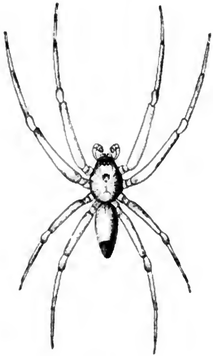
Frederic H. Krecker in the Ohio Journal of Science (1920, 20: 355) reports the discovery of caddis-fly larvae (*Rhyacophilidae*) whose cases instead of being attached to sponges, were supporting living colonies and apparently acting as distributing agents. The larvae were dredged from Put-in-Bay, Lake Erie and appeared to have been actively crawling about in the bottom rubbish. In this case it would seem that the association might be of advantage to the sponge if it, as a normally sessile animal, is more rapidly or widely distributed. At any rate the condition is interesting in its oppositeness to that found in the sponge from Isle-au-Haut.

A NEW SPIDER FROM ISLE-AU-HAUT, MAINE

Microneta bowditchiae nov. sp. (named for Miss Sally Bowditch, the discoverer) Male — 2.2 mm long. Cephalothorax yellowish brown, lighter on the disk; a narrow, curved, dark line from each posterior lateral eye to a small grey area in front of the dorsal groove. Lateral eyes contiguous and surrounded narrowly with black; posterior median narrowly ringed with black and the anterior median in an oval black spot that extends, in front, half way to the lower margin of the slypeus; eyes of posterior row in a straight line, equal in size and equidistant, slightly less than the diameter of one of them apart; anterior row straight or nearly so; the median eyes smaller and closer to each other than to the lateral. Height of clypeus about three times the diameter of an anterior median eye. Chelicera (Fig. 2) yellowish brown, narrowed distally and with a wide excavation on the inner distal third; a large tooth in front on the outer edge of the excavation and several inconspicuous ones on the inner edge; furrow of the chelicera very short unless the wide excavation is to be regarded as an extension of it; a large tooth near the base of each claw on the lower margin of the furrow. Abdomen above light grey with the apical third much darker; below dark except in front of epigastric furrow; legs yellow slightly dusky; sternum large, dusky yellow and prolonged between the hind coxae.

Palpus: (Fig. 7) The tibia is broadly dilated distally and armed with a few fine hairs. The cymbium of the tarsus is angular and has a bilobed apex and two knobs near the base (Fig. 3), paracymbium very broad and flat at the base but narrowed and sharply angled distally.

Remarks: *Microneta restangulata* Emerton (Tran. Conn. Acad. 1913, 18:217, pl. 2, figs. 5–5*b*) has the chelicera narrowed distally and with a small tooth on the front but the shape of the cymbium and paracymbium is very different and easily distinguished. *Bathyphantes micaris* Emerton (Tran. Conn. Acad. 1882, 6:71, pl. 22, fig. 5) has a cymbium that somewhat resembles it but there is no mention made of the peculiar excavations of the chelicera or of the large tooth in the front. Type locality, Isle-au-Haut, Maine. July, 1922. Type in the collection of the New York State Museum.



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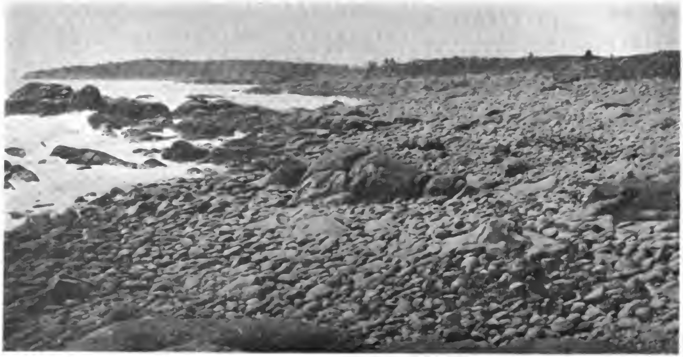
BOOM BEACH — A SEA MILL

By John M. Clarke

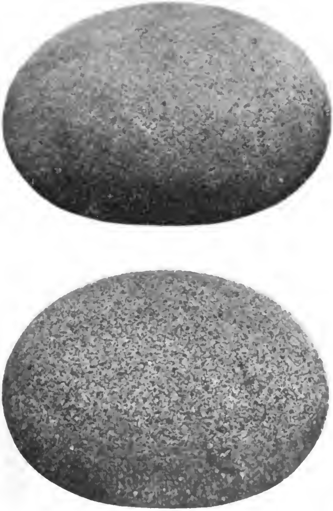
A novel expression of sea action as a geological factor is exhibited on Boom Beach which is a short stretch of the coast on the eastern shore of Isle-au-Haut, only a few rods away from the middle part of Turners Lake. This beach is perhaps a quarter of a mile in length and is bounded at the north and at the south by barricades of the rock pavement of the island which, though not high, exert an effective control of the movement of the waves. The beach is exposed to the full force of the Atlantic storm waves from the east. Doubtless the shallow waters bounding the island play over accumulations of large and small ice-worn glacial boulders, and this material washed up from the shallower depths is mixed with water-worn boulders of rocks indigenous to the island itself. The walled-in character of this sea exposure has resulted in piling up a tremendous mass of very heavy beach material of great width, its crest representing the highest reach of the storm waves, and as a further result the slope of the beach is steep. As the wave action on the beach is controlled by the sentinel rocks north and south, a boulder once caught in this place is ground up and down and back and forth over the other heavy stone of the beach, so that such a boulder seems to be a captive forever. Thus the beach material is made up of various sizes of stones up to a number of feet in diameter, which have been put through this milling process to a greater or less degree. The newer pieces, those which have been recently acquired by encroachment upon the rock beds of the land have only their native angles subdued, but those which have been longer subjected to the process are well rounded and approach a symmetry which is in accordance with the original shape of the angular blocks out of which they have been made. The ultimate result of this grinding process, so far as it is expressed in the form of the boulders, is a perfect or an approximate symmetry in the form of an ellipsoid, or an ovoid, or a spheroid or a discoid. The observer is at once impressed by the very large number of these symmetrically rounded blocks, all crystalline rocks and all shaped by the action of the sea. Nowhere has the writer seen so impressive an illustration of this ultimate result of the action of the sea on a beach of boulders.

This exposition leads to a further consideration for somewhat similar occurrences which are to be seen on smaller beaches similarly controlled by governing lateral rock walls. There is an old physiographic term long used by the Scotch and which the writer has applied on this side the Atlantic, namely, the word "goe" which means the place left on a sea coast through the removal by wave action of a prism of rock originally bounded by more or less vertical joint planes. The creation of such prismatic retreats and endroits on a coast gives it a peculiarly hatched aspect and often when carried to extreme, results in the creation of a natural bridge or a sea gully which may run through a projecting peninsular head from one side to the other. Such *goes* are common in the north of Scotland and in the Orkney Islands. They are also beautifully represented on the shore of the Forillon in Gaspé, where their place is taken by short crescentic beaches. On the south shore of Isle-au-Haut there are places at Western Head and the coves adjoining it, where the approximately north-south direction of the joint planes has permitted the sea to knock out rock prisms, leaving behind little retreats with sharply vertical rock walls and often a beach in which the small pebbles have been symmetrically rounded, the result being the same and due to the same causes as more extensively and emphatically expressed at Boom Beach. The illustrations accompanying this note show very effectively the results of this sort of sea milling.

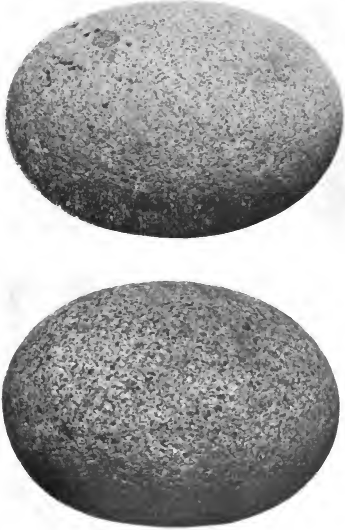


General view of Boom Beach from the north.

The pebbles on Boom Beach. A few selected at random.



Boulders from Boom Beach showing approximation to perfect ellipsoidal symmetry. These are all blocks of hypersthenite and quartzite.



Boom Beach boulders.

Boulder of perfect symmetry lying on the shore.

Series of small boulders of similar materials, all approximating a perfect symmetry.

A. H. Wright.

New York, December 31, 1923. No. 125

COPEIA

Published to advance the Science of cold-blooded vertebrates

NOTES ON THE HERPETOLOGY OF ALBANY COUNTY, NEW YORK, III.

The Snakes and Turtles

1. *Carphophis amoena* (Say). Worm Snake. A single specimen from Karners, N. Y. May 20, 1902. Collected by C. A. Trask and presented to the State Museum.

2. *Diadophis punctatus* (Linn.) Ring-neck Snake. Uncommon in Albany County; only two specimens taken in last 15 years.

3. *Heterodon contortrix* (Linn.) Hog-nose Snake, Spreading Adder. Fairly common in the sandy pine barrens west of Albany. Several specimens from Albany and Karners. A specimen received August 27, 1923, was taken within the city limits.

4. *Liopeltis vernalis* (Harlan). Smooth Green Snake. Apparently uncommon in Albany county although probably not as rare as indicated by the single definite record of the species. James Hall (24th Rept. State Museum, 1874, p. 17) records the capture of a young specimen in 1870 in the cellar of an Albany residence.

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5. *Coluber constrictor constrictor* (Linn.) Blacksnake. Recorded as early as 1835 by James Eights. Specimens from Aquetuck, N. Y. taken in August 1902 are in the Museum's collection.

6. *Lampropeltis triangulum triangulum* (Lacépède). Milk-snake. Common in the vicinity of Albany. Specimens from Glenmont, Bethlehem, Albany, Slingerlands and Aquetuck.

7. *Natrix sipedon sipedon* (Linn.) Water-snake. Very common, especially along the trout streams. Specimens from Albany, Wemple and Voorheesville.

8. *Storeria dekayi* (Holbrook). DeKay's Snake. Common, specimens recorded from Medusa, Kenwood, Albany and Voorheesville.

9. *Storeria occipito-maculata* (Storer). Red-bellied Snake. Less common than DeKay's snake but recorded from several localities in the County: Pine Hills, Albany, Indian Ladder, in Thacher Park.

10. *Thamnophis sirtalis sirtalis* (Linn.). Garter-snake. Very common. Found in numbers all over the county.

11. *Agkistrodon mokasen* (Beauvois) Copperhead. Two specimens taken in June or July 1910 in the hills near Ravena by Arthur Paladin and A. J. Cline.

12. *Crotalus horridus* Linn. Rattlesnake. The rattlesnake has not been found in recent years in Albany county but it is recorded by James MacCauley (Hist. N. Y. 1829, 1:514) from the Helderbergs; and in the 5th Ann. Rept. State Cab. Nat. Hist. 1852, p. 19, is the record of a specimen taken near the Schenectady road about four miles west of Albany city.

1. *Kinosternon odoratum* (Latreille). Musk Turtle. Not uncommon in ponds and muddy streams.

2. *Chelydra serpentina* (Linn.) Snapping Turtle. Common all over the county in suitable situations.

3. *Clemmys guttata* (Schneider). Spotted turtle. The few specimens from Albany county in the col-

lection are from New Salem swamp, Pine Hills
l. c and the Lake in Washington Park, Albany city.

4. *Clemmys insculpta* (Le Conte). Wood Turtle. Very common in the vicinity of Albany in open woods and meadows.

5. *Clemmys muhlenbergii* (Schoepff). Muhlenberg's Turtle. The first and only record of the species in Albany county was made May 28, 1923 with the capture of a mature male in Vly creek swamp near Meadowdale, New York

Vly creek has its origin in a series of cold springs near the base of the Helderberg mountains and flows southeastward and then east for about two miles through a number of more or less connected larch swamps and meadows. Where the stream borders one of the larger wooded areas it is possible in time of low water to record the activities of the various animals living in and about the stream by the trails left in the mud. On several occasions the tracks of turtles have been observed leading from and to the entrance of muskrat burrows. The turtle mentioned above was found on the stream bottom a short distance from one of the burrows and the tracks indicated that it had used the burrow as a convenient retreat.

6. *Terrapene carolina carolina* (Linn.) Box Turtle. James Eights (Zodiac, 1835, 1:62,132) reported the box turtle from the pine-barrens near Albany and it is also recorded by W. E. Taylor in the Proc. U. S. Nat. Mus. 1895, 17:579. No specimens have been received at the State Museum within the past few years but it has been reported from the woods near Slingerlands.

7. *Chrysemys picta* (Schneider). Eastern Painted Turtle. Common in the vicinity of Albany but many specimens vary from the normal both in scutellation and markings. A few seem to combine the characters of the eastern and western forms. State Museum No. 1204-9273, a female, has the

venter immaculate and the dorsal plates widely margined with yellow, but the plates are arranged as in the western species. A male, State Mus. No. 1188-9242, from Thacher park, has the venter with a dark central figure developed on the three posterior pairs of plates and the dorsal plates are arranged alternately; but the dorsal plates also have the broad yellow margin as in *C. picta.* The dark ventral figure has been frequently mentioned as one of the characters distinguishing the western species but many specimens have been observed in which this patch was entirely absent. Specimens from Sodus Bay, New York, have the ventral figure well developed but others from Canandaigua Lake, otherwise typically *C. marginata,* lack these markings entirely.

8. *Amyda spinfera* (Le Sueur). Soft-shelled Turtle. Recorded by James Eights (Zodiac, 1835, 1:24) from the Mohawk at Cohoes and by DeKay, (Zool. N. Y. pt. 3, 1842, p. 6). Holbrook (1842, 2:15) gives a circumstantial account of its occurrence in the Mohawk and Hudson Rivers.—S. C. Bishop, *State Museum, Albany, N. Y.*

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A. H. Wright

REMAINS OF A FOSSIL PHOCID FROM PLATTSBURG, NEW YORK

In 1901 the New York State Museum received from Dr. D. S. Kellogg, Plattsburg, New York, the tibia of a seal which had been recovered in October of that year from the post-glacial clays within the city limits. The bone was found at a depth of eleven feet below the surface during the construction of a sewer trench on Bailey Avenue. The soil at this locality was said to consist of a layer of sand four or five feet thick overlying fine clay. Fossil marine shells, *Macoma greenlandica* (Beck), were abundant in the upper part of the layer of clay but none were found at the depth of the imbedded bone.

The specimen has been examined by Mr. Remington Kellogg of the Biological Survey and the following statements quoted from a recent letter will indicate its affinities. "A young individual of *Cystophora cristata* (No. 14013, U. S. N. M.) from Newfoundland . . . . shows a very close approach to the fossil tibia. The lower extremity is approximately the same, including the facet for the fibula. The curvature of shaft and angle formed by the suture for the epiphysis of head, same as in *C. cristata*." The shaft of the tibia of the fossil specimen is a little thicker in the median region than is the condition in *C. cristata*. Although similar in essential characteristics to the recent specimen with which it was compared, it is perhaps best, on account of the fragmentary condition of the remains, to record the bone as the left tibia of a fossil phocid near *Cystophora cristata* Erxleb.—Sherman C. Bishop, *New York State Museum, Albany, N. Y.*

NEW YORK, NOVEMBER 15, 1921, NO. 100

COPEIA

Published to advance the Science of cold-blooded vertebrates

RECORD SAND SHARK FOR NORTHERN WATERS.

An unusually large specimen of the Sand Shark (*Carcharias taurus*) was captured on August 25, 1921, by Captain Charles Hurd of Clinton, Connecticut. Captain Hurd had set his gill-net at the mouth of Clinton Harbor, especially for menhaden for lobster bait. The shark became entangled in the gill-net and was drawn up to the gunwale of the boat. He was still alive and put up a vigorous fight but was finally despatched by two or three blows from a large hickory club which Captain Hurd carries in his boat for just such purposes. The shark was then towed ashore and hauled out on the beach. Its estimated weight was 250 pounds and it measured 8 ft. 10 in. over all. The jaws were removed, partially cleaned and taken to the American Museum of Natural History. The specimen was a female, but was without young.

GEORGE H. SHERWOOD,
New York, N. Y.

SELAR, A GENUS OF CARANGOID FISHES.

The generic name *Selar* was first defined by Bleeker in Nat. Tijdschr. Nederl-Ind.-I.-1851 (1852) page 352, in a paper entitled: *Over Eenige nieuwe Geslachten en Soorten van makreelachtige Visschen van den Indischen Archipel.*

Selar is here defined in the following terms:—"Dentes supramaxillares et inframaxillares, uniseriati, aegnales. Dentes vomeriis palatini linguales."

Bleeker further indicates a difference from *Decapterus* in the absence of finlets, and from *Caranx* proper in the longer body and straight profile. To this genus were referred "*Caranx plumieri* CV., *Caranx analis* CV., *Caranx djeddaba* Rup., etc." As Bleeker in this paper refers to work done at the "end of 1851 and the beginning of 1852," the actual date of the paper must be 1852, although in his own "Levensbericht" (1877), Bleeker places it at the head of his list of 1851.

In other papers of Bleeker of 1851 and 1852, published in the same journal (but all so far as I can ascertain of later date), I find the name *Selar* used in connection with other related species, all with elongate body, the jaws with equal teeth in a single row, and teeth also on vomer, palatines and tongue.

A few pages earlier (page 343) in the very same memoir, occurs a list of species of *Selar*, beginning with "*Trachurus trachurus* CV." and including *torvus* Jenyns, *boops* CV., *macrurus*, *hasselti*, *kuhli*, *brevis* and *malam* Bleeker, *para* CV., *djeddaba* Rüppell, *novae-guineae* and *microchir* CV.

If we recognize page priority, and at the same time respect Bleeker's later adopted rule of regarding the first species mentioned as type, *trachurus* must be chosen as such, and *Selar* become a synonym of *Trachurus* Rafinesque.

If we recognize page priority, and take the species in the above list first chosen as type by a later reviser we have the following: Jordan & Evermann, 1896, *Caranx boops* CV.; Jordan, 1919, (Genera of Fishes) *Selar hasselti*, Bleeker; Fowler, 1920, *Caranx boops* CV.

If we disregard page priority, we may take as type the first species actually named in connection with the generic description, *Caranx plumieri* CV. Or, following the "first reviser" rule, we must take *Caranx* *boops*. As both *plumieri* (= crumenophthalmus) and *boops* belong to the Genus *Trachurops* Gill, the name *Selar*, as Fowler has indicated, would replace *Trachurops*.

In any event, *hasselti* can not be taken as type of *Selar* and the group to which it belongs must, if recognized, find a new name.

I have referred the matter of *Selar* to our commission and quote a letter from the secreteary which I accept as conclusive. In this view *Selar* replaces *Trachurops* Gill.

"1. Referring again to your letter of July 22nd, in regard to *Selar*, I have looked up the original reference by Bleeker, 1851. If it can not be shown that Bleeker was using the 'first species rule' at this time, and that later he did not designate type, it seems to me obvious that as you and Evermann first designated the type in 1896a, p. 916, that your type-designation *boops* stands unchallenged.

"2. Were I ruling on the 'first species rule' I would take *Selar trachurus* as the type; but it is not clear to me that the 'first species rule' applies in this case. [Signed] C. W. Stiles."

DAVID STARR JORDAN,
Stanford University, Calif.

PURPLE SALAMANDER

The Purple Salamander, *Gyrinophilus porphyriticus* (Green), is one of the rarest salamanders of Pennsylvania. Any information as to its feeding habits should be of interest even though based on but a single observation as in the present instance.

On March 21 of this year, an adult purple salamander, measuring 6¼ inches in total length, was captured under a log lying near the edge of a brook in Castle Shannon, Alleghany County, Pennsylvania. It is difficult to say if this habitat is typical of the species. We have examined specimens captured in a spring and one taken from a rather deep lake.

The specimen was placed alive in a small tin box which contained several live specimens of the dusky salamander, *Desmognathus fuscus* (Rafinesque). A short time later all but two of the dusky salamanders were removed. On March 23 one of these two was seen in the box but on March 24 both had disappeared. Later the same day the purple salamander, while being handled, disgorged the two dusky salamanders. They had been eaten apparently head first since the head and anterior portions of the body were the most digested. It would be interesting to know if salamanders form the chief food of the purple salamander and if this form has a definite method of swallowing its prey.

P. H. Pope, *Pittsburg, Pa.*
G. K. Noble, *New York, N. Y.*

THE MAP TURTLE, *GRAPTEMYS GEOGRAPHICA* (LE SUER) IN NEW YORK

The Map Turtle which is usually reported in accounts of New York reptiles as occurring only in the western part of the State is particularly abundant in the warm shallow bays of the south shore of Lake Ontario. In Great Sodus Bay a few hours' collecting in September, 1920, resulted in the capture of 14 individuals, varying in length of carapace from $2\frac{1}{2}$ to 9 inches. Seven were seen at one time on the partly submerged hull of an old sail-boat and every suitable support in the vicinity held as many as could crowd upon it.

Extremely low water made their capture easy with a dip-net, as they could be followed in a boat and scooped up before finding refuge among the weeds of the deeper water. An early record of a specimen from Sodus Bay may be found in the 25th Report of the State Museum, 1873, p. 17.

This species is also to be found in Irondequoit Bay and a large female taken in November, 1917, is the

A. H. Wright

model of a fine cast in the exhibit series of the State Museum. Dr. A. H. Wright (*Copeia*, No. 66, p. 7) mentioned a carapace taken June 27, 1914, at Hilton Beach. DeKay (New York Fauna, pt. 3, 1842, p. 19) stated that the species was not uncommon in the streams of Chautauqua and Erie Counties.

The occurrence of the Map Turtle in Lake Champlain was made known in 1842 by Zadock Thompson in his "History of Vermont"; and it may now be definitely recorded from Lake George. On July 20, 1920, a large female was found on Juanita Island and on August 10, 1921, a very large specimen was seen basking on a stranded log at Elizabeth Island. This specimen was captured the following day about five hundred yards away in shallow water and while confined in a box disgorged several large and many small fragments of shells of the fresh-water clam, *Unio complanatus* (Sol), hundreds of individuals of which were living in the lake bottom mud and sand in the vicinity.

It may be conjectured that the eastern extension of the range of the Map Turtle in New York has been by way of the St. Lawrence River and that specimens in Lake Champlain and Lake George came in by way of the Richelieu River rather than by following the Erie and Champlain canals across the state.

SHERMAN C. BISHOP,
New York State Museum.

THE FOOD CAPACITY OF THE TOAD

On the evening of July 19, 1920, a medium sized toad (*Bufo fowleri* Putnam) came to my porch where the common southern May Beetle (*Lachnosterna ephilida* Say) was swarming about the lights. I soon noticed that this toad was devouring all of the May Beetles that he could reach with his tongue and after I had fed him a few it occurred to me that it might be a good thing to test his capacity for these beetles. The first night this toad ate forty-three beetles in an hour and five minutes. The night of July 20 it ate thirty-four in forty-five minutes. The night of July 21 it ate thirty-seven in an hour. The night of July 22 it ate thirty in an hour and a half. And the night of July 23 it ate twenty-six in two hours. On July 24 the flight of beetles was practically over and only seven beetles came to the light in three hours. Usually the first fifteen to twenty beetles would be eaten with apparently great relish, but after that it required considerable coaxing to get the toad to eat at all, and when the number eaten got to the thirties the toad would take his front feet and literally cram the beetles down his throat at the same time going through a series of contortions which seemed to put that beetle into its proper cranny. These maneuvers were very comical and reminded me of the actions of a small boy at a picnic trying to eat just one more piece of cake. In each case, excepting the night of July 24, when the flight of beetles was practically over, the numbers given represent all that I could get the toad to eat. After it had eaten its fill it might look at a beetle placed before it but usually it turned its back on all such proffers and if the efforts were persisted in the toad hopped away from the porch in disgust.

This represents a total of 177 May Beetles destroyed in five days and if each one of these eighty-eight pairs laid 50 eggs this one toad prevented the development of 4,400 white grubs on my lawn.

It is only fair to state that *Lachnosterna ephilida* is one of the smaller May Beetles. It averages about fifteen millimeters in length and about seven in diameter and weighs, when dry, about 150 milligrams.

Z. P. Metcalf,
Raleigh, North Carolina.

THE TYPE LOCALITY OF *CROTALUS WILLARDI* MEEK

Crotalus willardi was described by S. E. Meek (Field Columb. Mus., Zool. Ser., 7, Nov., 1905, p. 18, pl. 3) on the basis of a single specimen stated by him to have come from Tombstone, Arizona. Stejneger and Barbour, in their *Check List of North American Amphibians and Reptiles* (1917, p. 111) again give the type locality of this species as Tombstone, Arizona. The species was named for Mr. Frank C. Willard, who collected the type specimen. Mr. Willard resided at Tombstone at the time, but he made many spring and summer trips to certain of the nearby mountain ranges, and it occurred to me as a likely possibility that this snake was collected on some of those outings.

An appeal to Mr. Willard for information elicited the following reply: "In regard to the rattlesnake which I found, it is my certain knowledge that it was taken in the Huachucas, and my recollection is that it was captured a short distance above Hamburg in the middle branch of Ramsey Canyon." This locality is about thirty miles southeast of Tombstone, not so very far in linear distance, but in a different life zone and amid totally different faunal surroundings. The point indicated is in the Huachuca Mountains in Ramsey Canyon, at about 7000 feet altitude and well up in the Transition Zone. It is a very different region indeed from the stony, *Covillea*-covered, Lower Sonoran mesa upon which Tombstone is situated, and the difference is worth knowing by any student of geographical distribution, in reptiles as well as in any other group of animals.

H. S. Swarth,
University of California.

AN EASTERN RECORD AND A NOTE ON *CHARINA BOTTAE* (BLAINVILLE)

While driving through Shoshone Canyon, July 11, 1921, a *Charina* was collected four miles west of Cody, Wyoming. As far as I can determine this is the most eastern record for *Charina bottae*.

The snake was found in one of the few small open spaces along the road in the canyon. Because of the relative scarcity of specimens of this species I have given this specimen (now U. of Mich. No. 56253) to the Museum of Zoology, University of Michigan.

The Boa is like the typical *Charina bottae* except that the temporal plate is much reduced.

It is interesting to note that it differs from the specimens which Van Denburgh (Calif. Acad. Sci. Vol. X, No. 3, pp. 31-32, Aug. 6, 1920) described from Utah as *Charina bottae utahensis*. His new subspecies is based upon seven specimens each having 41 scale rows while the *C. bottae* of the more western states have from 43-49 scale rows. My specimen collected about 125 miles east of the more eastern record of *C. b. utahensis* of Van Denburgh has 43 rows. The most eastern record of the U. S. N. M. (No. 60237) from Chico, Montana, has 43 scale rows.

A. I. Ortenburger,
Ann Arbor, Michigan.

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New York State Museum

JOHN M. CLARKE, Director

A REVISION OF THE PISAURIDAE OF THE UNITED STATES

(WITH SPECIAL REFERENCE TO THE NEW YORK SPECIES)

BY

SHERMAN C. BISHOP

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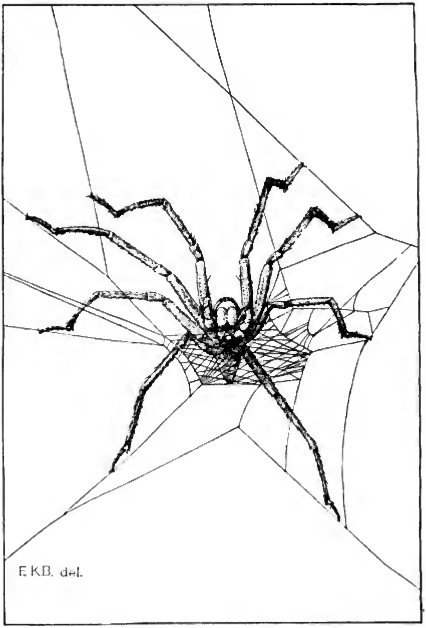

Pisaurina mira (Walckenaer)

In the process of sperm induction the male constructs a small, vertical web, deposits the spermatic fluid in a small drop near the top and, after moving to the opposite side, takes up the sperms by reaching over the top of the web and applying the palpi alternately.

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A REVISION OF THE PISAURIDAE OF THE UNITED STATES

(WITH SPECIAL REFERENCE TO THE NEW YORK SPECIES)

BY

SHERMAN C. BISHOP

INTRODUCTION

This important group, scientifically known as the family Pisauridae, includes some of the largest of our true spiders. The various species are widely distributed; they are common in many localities and often conspicuous but, from the point of view of the systematist, they have long been in a state of great confusion. This condition may be accounted for in part by the lack of type material, but to a larger extent it is due to the extreme variability to which many species are subject. Disparity of sizes in the sexes of certain species has also been a disturbing element. It has not been possible to recognize some of the species described in early accounts where color and size were the only characters considered; but they have been listed in this revision in the hope that more intensive collecting will reveal representatives of at least a few of them. The types of the earlier described species, those of Walckenaer, De Geer, Koch, and Hentz, have long since disappeared; at least they are not now known in collections. Of those described more recently, I have seen Maypacius floridanus Simon, and Pisaura brevipes Emerton. The drawings by John Thomas Abbott, preserved in the British Museum, have never been published but copies of the pisaurids have been furnished me for use in this study.

The family Pisauridae is a cosmopolitan one composed of thirty odd genera distributed most freely in the tropical and semitropical regions but strongly represented in the temperate zones by several well-defined genera. Of the five genera and seventeen species here recognized from America north of Mexico, one genus is new and one reported for the first time. Four of the seventeen species recorded are new.

ACKNOWLEDGMENTS

The chief source of materials has been the splendid collection of the department of entomology at Cornell University, which was placed unreservedly at my disposal through the kindness of Professor C. R. Crosby. I am also particularly indebted to Professor Crosby for his continued interest in this report and critical examination of the manuscript. For the use of the valuable series of specimens in the Museum of Comparative Zoology at Cambridge, my thanks are due Dr R. V. Chamberlin, Mr Samuel Henshaw and Mr Nathan Banks. Dr F. E. Lutz of the American Museum, New York, Dr. J. M. Aldrich and Mr H. E. Ewing of the National Museum and Dr Eugene A. Smith of the University of Alabama kindly loaned the specimens placed in their care. Smaller collections have been received from Mr J. H. Emerton of Boston, Dr Frank N. Blanchard of the University of Michigan, Dr Charles P. Alexander of the Massachusetts Agricultural College, Dr S. J. Hunter of the University of Kansas and Mr William Barrows of the Ohio Biological Survey. Dr A. H. Wright and Mr Francis Harper of the department of zoology, Cornell University, collected and contributed a valuable series of Dolomedes from the Okefinokee swamp, Georgia. The private collection of Mr C. R. Shoemaker of Washington, D. C., is rich in pisaurid material collected chiefly in the District of Columbia and Virginia. Dr L. Berland and M. Eugene Simon of the National Museum of France sent to me for examination the type, and at the time, the only known specimen of Maypacius floridanus. My own collections have been made chiefly in various parts of New York State and Georgia, and the specimens are deposited in the New York State Museum. My former assistant, Miss Fanny T. Hartman, and local collectors, Mr W. J. Schoonmaker of Rensselaer and Mr Hugh P. Chrisp of Albany, have contributed valuable specimens and observations.

My thanks are also due Professor J. H. Comstock for permission to use the splendid photograph of Pisaurina mira on her nursery.

With two exceptions, the drawings accompanying the report are the work of Anna Clegg Stryke of Pasadena, Calif., who is not only an artist of exceptional ability but an accomplished student of aranean anatomy.

THE FAMILY PISAURIDAE

Characters of the family. The characters enumerated below apply to the family as it is represented in faunal area under consideration:

Cephalothorax longer than broad, somewhat constricted in the cephalic region: dorsal groove well defined, radial grooves less prominently marked; eyes eight, those of the anterior row noticeably smaller than the others except in Pelopatis and Thanatidius where they are almost equal; anterior row straight, recurved or procurved; abdomen regularly oval (Dolomedes and Thaumasia), moderately long (Pisaurina), or long and narrow (Thanatidius and Pelopatis); spinnerets in a compact group at the end of the abdomen; the pedicle short with its superior lorum composed of two median segments and a pair of accessory lateral sclerites; median segments united by a transverse suture in Pisaurina, the anterior segment notched behind to receive a projection of the posterior segment in Dolomedes, or as in Pelopatis, Thanatidius and Thaumasia, the anterior segment is gently rounded behind and fits the shallow excavation of the posterior segment. The relation of the median segments in the genera last named approaches the condition found in the genus Lycosa; but the lateral accessory sclerites are differently developed. In Lycosa, the lateral pieces are confined to the sides of the posterior median segment while in the pisaurids they extend along the sides of the anterior segment as well, sometimes, as in Pelopatis and Thanatidius, less than one-half its length or as in Thaumasia, its entire length. Corresponding to the general body development, the legs are relatively strong in Dolomedes and Thaumasia, less robust in Pisaurina, and long and slender in Pelopatis and Thanatidius; tarsi provided with three variably toothed claws. Tibiae of the pedipalps of the males provided with an external apophysis. The structure of the palpal organ of a typical pisaurid may be understood by reference to the accompanying figure (1) on which (following the terminology of Comstock) the parts are named.

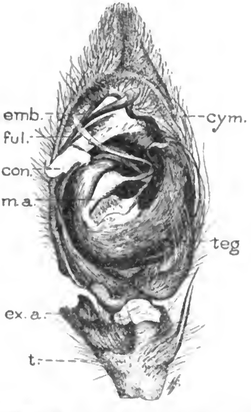

Fig. 1 Unexpanded bulb of Dolomedes tenebrosus Hentz. The tibia (t) is short and thick and bears an external apophysis (ex.a); the body of the tarsus or cymbium (cym) is concave internally and partially incloses the genital bulb and its accessory appendages; the tegulum (teg.) is a heavily chitinized sclerite forming part of the wall of the genital bulb and contains the receptaculum seminis; the tegulum bears an appendage, the median apophysis (m.a.), slender and semi-transparent in this species but well developed and stout in other species of the genus. The conductor (con) is membranous, attached to the middle division of the bulb and lies below the tip of the grooved fulcrum (ful) which in turn supports the tip of the embolus (emb).

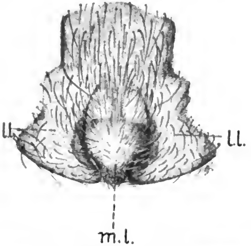

Fig. 2 Epigynum of Dolomedes trition (Walckenaer).

In the Pisauridae the epigynum is well developed and consists of three parts; a median lobe or guide (m.l.) and more or less well developed lateral lobes (l.l.–l.l.) with chitinized inner margins. The openings of the internal reproductive organs are concealed by the inner margins of the lateral lobes and are reached by the curved embolus of the male.

In some species, D. tenebrosus and D. okefinokensis, the median lobe is highly developed and forms the larger part of the epigynum; in others, D. scriptus, D. albineus etc., it is inclosed by the lateral lobes which unite across the front and converge posteriorly.

Family relationships. The pisaurids have as their nearest relatives in North America the spiders of the families Lycosidae and Agelenidae. They have only recently been separated from the former although the arrangement of the eyes and possession of the tibial apophysis immediately distinguishes them. The members of both the Pisauridae and Lycosidae have the distal margin of the trochanters broadly notched beneath, a characteristic lacking in the Agelenidae. In the Agelenidae the hind spinnerets are usually longer than the fore, and sheet webs are laid for the capture of prey. The pisaurids in our fauna capture their prey by stalking, and confine their use of silk to the drag line, egg sac and nursery web.

The pisaurid egg sac has a continuous covering of silk and is carried in the chelicera; that of the Lycosidae is composed of two valves and is dragged from the spinnerets until the young are hatched and, in some cases, transferred to the back of the mother.

The young of many spiders develop from eggs neglected by the mother after deposition, but with the pisaurids the egg sac is not only protected but a web is spun for the use of the young until they have developed sufficiently to look after themselves. The females of Dolomedes spin the nursery web only when the young are beginning to emerge from the sac but Pisaurina mira fashions a retreat of leaves and silk, suspends herself with her sac to await development of the eggs, and expands the nursery by adding lines when the young emerge. Nothing is known of the breeding habits of Pelopatis and Thanatidius.

Most of the species are found in the vicinity of water, hiding under stones or rubbish, stalking insects among the herbage along shore or running freely over the surface of ponds or slow streams. Some commonly take refuge beneath the surface when pursued and cling to submerged vegetation. Structural modifications such as a brush of soft hairs on the ventral surface of the terminal segments of the legs to permit surface navigation, and the hairy investment of the body for entangling air when submerged, have accompanied the adoption of the semi-aquatic habit.

References to literature. The genera constituting the family Pisauridae were formerly distributed among other families, those of America chiefly in the Lycosidae but, in the case of Pelopatis and Thanatidius, in a separate group — the Podophthalmidae. Some references to the earlier literature are given below, and include accounts of American genera described under various families.

Lycosoidae **Thorell,** On European Spiders, Upsala, 1869, pp. 188–195

Lycosoidae **Keyserling,** Verh. K. K. Zool. Bot. Ges. Wien, 1876, 26:610–680, pls. 7–8

Lycosidae **Simon,** Les Arachnides de France, 1876, 3:223–360; v. 4, 1878, pls. 12–13

Lycosidae **Thorell,** Synonyms of European Spiders, Upsala, 1870–1873, pp. 271–355

Lycosidae **Emerton,** Tran. Conn. Acad. 1885, 6:481–505, pls. 46–49 — Includes Dolomedes, Ocyale etc., with typical Lycosidae.

Lycosidae **Marx,** Proc. U. S. Nat. Mus., 1890, 12:560–566. Dolomedes and Ocyale.

Podophthalmidae **Marx,** Ibid, p. 567. Thanatidius dubius etc.

Lycosidae **Stone,** Proc. Acad. Nat. Sci. Phila., 1890, 42:420, pl. 15, fig. 8

Lycosidae **Banks,** Can. Ent. 1892, 24:97 (Dolomedinae)

Pisauridae **Simon,** Hist. Nat. des Araignées, 2d ed., 1898, 2:278–316, figs. 284–326

Lycosidae **Emerton,** The Common Spiders of the U. S., Boston, 1902, p. 67

Lycosidae **Montgomery,** Proc. Acad. Nat. Sci. Phila., 1902, 54:534–592

Pisauridae **Comstock,** A Classification of N. Amer. Spiders, Ithaca, 1903, pp. 50–51

Pisauridae **Banks**, Amer. Nat., 1905, 39:318
Pisauridae **Bryant**, Occ. Papers Bost. Soc. Nat. Hist., 7, 1908, p. 79
Pisauridae **Banks**, U. S. Nat. Mus. Bul. 72, 1910, p. 53
Pisauridae **Petrunkevitch**, Bul. Amer. Mus. Nat. Hist., 1911, 29: 539-549
Pisauridae **Comstock**, The Spider Book, N. Y., 1912, pp. 598-617, figs. 683-710

List of species. The species described or mentioned by various writers and assigned to the family Pisauridae are listed below; some have been found to belong in other families and in these cases the synonymy has been noted.

Species of De Geer

Mem. L'Hist. des Insectes, 1778, v. 7

Aranea rufa, p. 319, pl. 39, fig. 6. Regarded by Banks (Ent. News, 1898, 9:142) and Petrunkevitch (Bul. Amer. Nat. Hist., 1911, 29:541-542) as identical with Hentz's Dolomodes albineus. The description is insufficient for identification, the figure is useless and the locality, Pennsylvania, is too far north for this distinctively southern spieces. (See remarks under account of Dolomedes albineus Hentz.)

Species of Walckenaer

Hist. Nat. des Insectes Apt., 1837, v. 1

It has been the general practice to regard Walckenaer's species as invalid because they were believed to be based entirely on the unpublished drawings of Abbot. In some instances however there is direct evidence that specimens as well as the drawings were before the author and in such cases (provided the species can be recognized) Walckenaer's names are used.

Lycosa triton, p. 340. Petrunkevitch[1] was the first to point out the identity of this species with Dolomedes sexpunctatus Hentz. It is the "water spider" of Abbott, pl. 19, fig. 91.

Dolomedes vittatus, p. 347. This is the female of the species described by Hentz as Dolomedes lanceolatus. Abbot, pl. 5, fig. 21.

Dolomedes lineatus, p. 347. Two varieties are mentioned by Walckenaer (Abbot, pl. 11, fig. 51, " varieté jaune," and pl. 12, fig. 56, " varieté rouge "). The first variety, fig. 51, is very likely Lycosa rabida Walckenaer. The species represented in the second variety fig. 56, may be, according to the opinion of Professor R. V. Chamberlin, Lycosa punctulata Hentz.

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[1] Ann. N. Y. Acad. Sci., 1910, 19:219-220.

Dolomedes rufus, p. 351. Walckenaer had at least two specimens before him and in addition, Abbot's four figures; these he regarded as representing varieties of the single species and identical with De Geer's Aranea rufa. Two of the drawings bear no resemblance to any known American species and the other two can not be placed with any certainty. Walckenaer's description in itself is insufficient for purposes of identification.

Dolomedes mirus, p. 357. This species was selected by Simon as the type of the genus Pisaurina. Abbot (pl. 65, fig. 321) represents an immature male with the legs rather short and the color pattern quite unlike any of the familiar varieties. In the description however—and Walckenaer must have had specimens before him—the species is likened to Pisaura (Dolomedes) mirabilis of Europe, Africa etc., a form not unlike our species in color pattern.

Dolomedes virgatus, p. 358, Abbot, pl. 59, fig. 291. This is Pisaurina mira Walck.

Species of Koch

Die Arachniden, 1848, v. 14

Ocyale rufa, pp. 112–114, tab. 483, fig. 1349. Under the generic name Ocyale, Koch described and gave a figure of a specimen which he believed to represent Aranea rufa of De Geer and Dolomedes rufus of Walckenaer. I have been unable to place this species which resembles in a slight degree the Dolomedes scriptus of Hentz but lacks entirely the distinctive characters of D. albineus.

Dolomedes oblongus, p. 114, pl. 484, fig. 1350. Now placed by Petrunkevitch in Diapontia of the Lycosidae.

Dolomedes scapularis, pp. 119–120, tab. 486, fig. 1354. Here considered a synonym of Dolomedes triton Walckenaer but recorded doubtfully, by Cambridge[1], in Thaumasia.

Dolomedes binotatus, pp. 121–122, tab. 487, fig. 1356. A large yellowish-brown species with a pair of black spots on the back of the abdomen in Koch's figure. No specimens have been found in the United States that agree with the description or figure. Cambridge loc. cit. places it doubtfully in Thaumasia.

Dolomedes aerugineus, pp. 122–123, tab. 487, fig. 1357[2]. This species is recorded from "Amerika" so probably not from the United States. It is represented as being uniform yellowish or reddish-brown and quite different from any of the familiar American species.

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[1] Proc. Zool. Soc., London, 1903, 73:154

[2] See Banks, Jour. N. Y. Ent. Soc., 1901, 9:186.

Dolomedes marginellus, p. 120, tab. 486, fig. 1355. Petrunkevitch[1] following Simon, places this in the genus Thaumasia. Specimens, apparently of this species, from Cuba have four teeth in the lower margin of the furrow of the chelicera and other characters of the genus Dolomedes. It has not been recorded from the United States.

Species of Hentz

Bost. Jour. Nat. Hist., 1844, v. 4

Dolomedes tenax, p. 395, pl. 19, figs. 7-8. A small species described from specimens taken in North Carolina. It is unknown in collections and may prove to be the young of some species described under another name.

Dolomedes hastulatus, pp. 395-396, pl. 19, fig. 9. Another small species said to have been found in September in a web resembling that of Agelena. Perhaps not a pisaurid although the figure gives the general proportions of Dolomedes with an indication of the pattern of D. albineus.

Dolomedes tenebrosus, p. 396, pl. 19, figs. 10, 13. A common species both in the north and south and perfectly distinct from D. scriptus with which it has sometimes been confused. It is closely related to a species which I have described as new from the Okefinokee swamp in Georgia but differs sufficiently in the various structures to enable it to be immediately distinguished.

Bost. Jour. Nat. Hist., 1845, v. 5

Dolomedes scriptus, p. 189, pl. 16, fig. 1. Dolomedes fontanus Emerton is a synonym. The figure given by Hentz shows the characteristic color pattern of the abdomen.

Dolomedes albineus, pp. 189-190, pl. 16, fig. 2. Described from Alabama. The male has not been figured heretofore.

Dolomedes urinator, pp. 190-191, pl. 16, fig. 3. Long considered to be the female of the species described by Hentz under the name of Dolomedes lanceolatus; now believed to be distinct The male is unknown.

Dolomedes lanceolatus, p. 191, pl. 17, fig. 12. A synonym of Dolomedes vittatus Walckenaer.

Dolomedes sexpunctatus, pp. 191-192, pl. 16, figs. 5-6. Here regarded as a subspecies of Dolomedes triton Walckenaer.

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[1] Bul. Amer. Mus. Nat. Hist, 1911, 29:547.

Thomisus? dubius, p. 448, pl. 23, fig. 11. Placed by Simon in the genus Thanatidius.

Thomisus? tenuis, p. 449, pl. 23, fig. 12. Apparently the species described by Simon as Maypacius floridanus. Goes in Thanatidius.

Micrommata undata, pp. 192–193, pl. 16, fig. 7; M. serrata, p. 193, pl. 16, fig. 8; M. marmorata pp. 193–194, pl. 17, fig. 5; M. carolinensis p. 194, pl. 16, fig. 9. Synonyms of Pisaurina mira Walckenaer.

Bost. Jour. Nat. Hist., 1850, v. 6

Micrommata subinflata, p. 288, pl. 10, fig. 13. A color variety of Pisaurina mira Walckenaer.

Micrommata pinicola, p. 287, pl. 10, fig. 14. Banks collected an immature spider at Punta Gorga, Fla., which agrees so well with the description and figure of Hentz that there is little doubt of its identity. It was placed in the genus Thaumasia in Banks' catalog[1] but earlier recorded[2], provisionally, as an immature Dolomedes albineus. Comstock[3] regarded it as belonging in Dolomedes and it is so considered in this revision.

Species of Giebel

Zeitschr. fur die Ges. Natur., 1869, v. 33

Dolomedes striatus, p. 252. Placed as synonym of D. tenebrosus by Petrunkevitch but is here regarded as a distinct species.

Dolomedes convexus, pp. 252–253. A small species from Illinois which I can not now place. Lacks the distinctive characters of Dolomedes triton Walck., with which it was placed by Petrunkevitch.

Species described or mentioned by Emerton

Tran. Conn. Acad., 1885, v. 6

Ocyale undata, p. 499, pl. 49, figs. 7, 7a. Equals Pisaurina mira Walckenaer.

Dolomedes sexpunctatus, p. 501, pl. 49, figs. 8, 8a. Here regarded as a subspecies of Dolomedes triton Walckenaer.

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[1] Bul. 72 U. S. Nat. Mus., 1910, p. 54.

[2] Proc. Acad. Nat. Sci. Phila., 1904, p. 136.

[3] The Spider Book, N. Y., 1912, p. 617.

Dolomedes tenebrosus, p. 501, pl. 49, figs. 9, 9*a*, 9*b*, 9*c*. Figures 9*a* and 9*b* represent the palpal organ and tibial apophysis of Dolomedes vittatus Walckenaer; figure 9*c* is the epigynum of Dolomedes scriptus Hentz.

Tran. Conn. Acad., 1909, v. 14

Dolomedes idoneus, p. 211, pl. 7, fig. 8. This is Dolomedes tenebrosus Hentz.

Dolomedes vernalis, pp. 211, pl. 7, figs. 7–7*d*. Figure 7 represents the male and 7*b* the epigynum of Dolomedes tenebrosus.

Dolomedes sexpunctatus, p. 210, pl. 7, figs. 6, 6*a*, 6*b*. I am inclined to believe that figure 6 represents an immature female of Dolomedes striatus Giebel; at least it has the markings of this species. Figures 6*a* and 6*b* represent the palpal organ and dorsal aspect of Dolomedes triton Walck.

Species of Keyserling

Verh. Zool. Bot. Ges. Wien., 1887, 37:486, pl. 6, fig. 42

Tetragonophthalma undulata. This species does not belong in Tetragonophthalma nor in Thanatidius of which T. dubius Hentz is the type. It is regarded in this revision as the type of a new genus.

Species described or mentioned by Simon

Annales de la Société Entomologique de Belgique, 1898, 42:14

Maypacius floridanus Simon is very probably the species described by Hentz as Thomisus tenuis. Goes in the genus Thanatidius.

Hist. Nat. Araignées, 1898, 2:293

Thanatidius dubius. Simon selected Thomisus dubius Hentz as the type of the genus Thanatidius but gave a description of the species earlier described by Keyserling as Tetragonophthalma undulata. Keyserling's species did not belong in Tetragonophthalma and Simon's name (Thanatidius) must be retained because the type (Thomisus dubius Hentz) was designated.

Species described or mentioned by Montgomery

Proc. Acad. Nat. Sci. Phila., 1902

Ocyale undata, p. 584, equals Pisaurina mira Walckenaer.

Dolomedes idoneus, pp. 588–590, pl. 30, fig. 51. The figure of the epigynum shows this to be Dolomedes tenebrosus Hentz.

Subdivisions of Pisauridae. Simon separated the Pisauridae into three rather ill-defined groups designated respectively the Pisaureae, Thalassieae and the Dolomedeae. The first embraced a considerable number of genera distinguished by having the median ocular area slightly longer than broad posteriorly and the tarsi generally provided with an onychium. But in the three American genera included in Pisaureae, Pelopatis has this area broader posteriorly than long and in Thanatidius and Pisaurina the dimensions are about equal.

In structure of the epigynum and palpus, closer agreement is found and upon these characters, rather than eye arrangement, subfamily distinctions may possibly be made. Based on the structure of the sexual organs, the genera named above would fall in one group and Dolomedes and possibly Thaumasia in a second; Thalassieae has no representatives in America north of Mexico.

Key to the Genera of Pisauridae

A Eyes in two rows; width of clypeus at least twice the diameter of an anterior median eye
  B Lower margin of the furrow of the chelicera with three teeth
    C Median ocular area about as wide posteriorly as long; teeth evenly spaced PISAURINA
    CC Median ocular area much wider posteriorly than long; two teeth close together, the third somewhat remote THAUMASIA
  BB Lower margin of the furrow of the chelicera with four teeth DOLOMEDES
AA Eyes in 3 or 4 rows; clypeus narrow or obliterated
  B Line of anterior lateral eyes (first row) about equal in width to that of posterior median eyes (third row) THANATIDIUS
  BB Line of anterior lateral eyes (first row) much wider than that of posterior median eyes (third row) PELOPATIS

THANATIDIUS (Simon)

Hist. Nat. Araignées, 1898, 2:293

Cephalothorax longer than broad, somewhat depressed; cephalic part up to posterior eyes, ascending; broad and flat behind posterior eyes to posterior declivity. *Eyes* in four rows, the total area not quite as long as broad posteriorly; line of anterior lateral eyes (first row) scarcely wider than line of posterior medium eyes (third row); area outlined by four median eyes a little wider posteriorly than long; area of four anterior eyes considerably wider anteriorly than long; anterior lateral eyes on stout conical tubercles projecting from anterior margin of head. Lower margin of furrow of chelicera with three teeth. *Abdomen* long and slender. Legs 1-2-4-3; tibia of first and second legs beneath with 2-2-2-2 spines, apical pair reduced; metatarsi with 2-2-2-2 spines beneath, apical short.

The genus Maypacius Simon is related but differs in having two teeth on the lower margin of the furrow of the chelicera, the area of the four median eyes longer than wide and the area of the four anterior eyes hardly wider than long.

Type of the genus: Thomisus dubius Hentz.

Maypacius Simon, Hist. Nat. Araignées, 1898, 2:288, 292 (ad part)
Maypacius Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 54
Maypacius Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:544
Maypacius Comstock, The Spider Book, N. Y., 1912, p. 605

Key to the Species of Thanatidius

A Lateral lobes of epigynum broadly in contact on the middle line behind; median lobe rectangular, deeply notched behind T. dubius (Hentz)
AA Lateral lobes of epigynum narrowly in contact on middle line behind; median lobe long and narrow T. tenuis (Hentz)

Thanatidius dubius (Hentz)

Bost. Jour. Nat. Hist., 1847, 5:448, pl. 23, fig. 11

Type: Thomisus? dubius Hentz; type specimen not known to exist
Type locality: North Carolina
Female (alcohol): length 9 mm; legs 1-2-3-(4th missing), 22-21-16-(?) mm; pl. 1; pl. 33, fig. 2, epigynum.

Cephalothorax above with a broad, median light brown band, clothed with short, light brown hair; the band incloses the eyes and extends entire length of cephalothorax; back of posterior eyes an oval area lighter, with a narrow, line like extension through the dorsal groove; sides of cephalothorax light yellowish white clothed with white hairs; extreme margin with a fringe of white; a pencil of long, white hairs extending forward between median eyes. *Eyes* equal in size or nearly so except posterior lateral which are slightly larger; triangle of four anterior eyes, wider in front than long; anterior lateral eyes separated by about twice the diameter of one of them and slightly farther apart than posterior median. *Chelicera* yellowish white spotted irregularly in front with black; lower margin of the furrow with three teeth. *Abdomen* above with a broad median band, dark brown, clothed with short, brown hairs and narrowly margined with white; a broad band yellowish white and bearing white hairs each side of median dark band; venter of abdomen with sides light brown; back of epigastric furrow dusky yellow with two dark lines extending from epigynum half way to spinnerets. *Legs* long, slender, light yellowish brown above, dusky beneath with small scattered spots of dark gray; coxae of third and fourth legs darker than those of first and second pairs; *Sternum* dark gray with light yellow border and stripe through middle of anterior half. *Epigynum* (pl. 33, fig. 2) prominently raised on epigastrium, heavily chitinized; median lobe convex and notched behind, lateral lobes broadly in contact posteriorly. Male unknown.

Synonymy

Thomisus? dubius Hentz, Bost. Jour. Nat. Hist., 1847, 5:448, pl. 23, fig. 11
Thomisus? dubius Hentz, Proc. Bost. Soc. Nat. Hist., 1868, 11:106
Thomisus? dubius Hentz, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 82, pl. 10, fig. 11
Thanatidius dubius Simon, Hist. Nat. Araignées, 1898, 2:288, 293
Thanatidius dubius, Banks, Proc. Acad. Nat. Sci. Phila., 1900, 52; 539

Remark. Simon designated Thomisus dubius Hentz as the type of the genus Thanatidius but the diagnosis he gives does not correspond to the characters of the type as described and figured by Hentz. The characters given in Simon's definition of the genus were very evidently based on a specimen of Tetragonophthalma undulata Keyserling, a species perfectly distinct but not belonging in Tetragonophthalma and therefore in this revision, made the type of a new genus.

T. dubius and T. tenuis have been very generally regarded as identical; they resemble one another in general proportions and arrangement of the eyes but differ in size, in the structure of the epigynum, and development of the color pattern. A mature female collected by Nathan Banks at Auburn, Ala., and recorded in the Proc. Acad. Nat. Sci. Phila., 1900, 52:539, is T. dubius.

Distribution. North Carolina, *Auburn, Ala.; *Washington, D. C.

Thanatidius tenuis (Hentz)

Bost. Jour. Nat. Hist., 1847, 5:449, pl. 23, fig. 12

Type: Thomisus? tenuis Hentz; type specimen not known to exist
Type locality: Alabama
Female (alcohol): Length 8mm; legs 1-2-4-3; pl. 2, figs. 1-5

Cephalothorax dull yellowish above, lighter on the cephalic part and in front of the dorsal groove; between the median eyes a prominent brush of long, white hairs extending forward; sides of cephalothorax sparsely covered with short, yellowish brown hairs in patches. *Eyes* (pl. 2, fig. 2) almost of equal size, the posterior lateral slightly larger; four anterior eyes form a triangular area one and one-half wider anteriorly than long; anterior lateral eyes protuberant from anterior margin of head thus obliterating the clypeus; anterior lateral margins of the head prominently angled; transverse space occupied by the anterior lateral eyes only a little wider than that of posterior median eyes. *Chelicera* yellowish white spotted in front with black; lower margin of furrow armed with three teeth (pl. 2, fig. 5); (the third in Simon's specimen somewhat reduced). *Abdomen* above with a median dusky band widest in front, tapering to spinnerets; on each side of median band near base, a small, dark spot; ground color bordering median band yellow with darker reticulations and a row of small, irregular, black spots along the sides; venter behind genital furrow reticulated as above. *Legs* above dusky yellow, gray or black beneath except coxae which are spotted. *Sternum* gray with a median light line and irregular marginal bands of yellow. *Labium* and endites dusky yellow spotted with black, lighter distally. The *epigynum* (pl. 2, fig. 1) resembles that of Pelopatis undulata (Keyserling). Male not known.

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*This character indicates that specimens have been examined from localities mentioned.

Synonymy

Thomisus? tenuis Hentz, Bost. Jour. Nat. Hist., 1847, 5:449, pl. 23, fig. 12

Thomisus? tenuis Hentz, Proc. Bost. Soc. Nat. Hist., 1868, 11:106, figs. 84, 101

Thomisus? tenuis Hentz, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 82, pl. 10, fig. 12; pl. 18, figs. 84, 101

Maypacius floridanus Simon, Ann. Soc. Ent. Belgique, 1898, 42:14

Maypacius floridanus Simon, Hist. Nat. Araignées, 1898, 2:288

Thanatidius tenuis Simon, Hist. Nat. Araignées, 1898. 2:293

Maypacius floridanus, Banks, Bul. 72, U. S. Nat. Mus., 1910, p. 54

Maypacius floridanus, Banks, Proc. Acad. Nat. Sci. Phila., 1904, 56:136

Maypacius floridanus, Comstock, The Spider Book, N. Y., 1912, p. 605

Maypacius floridanus, Banks, Proc. Acad. Nat. Sci. Phila., 1913, 65:181, pl. 12, fig. 30

Remarks. Through the courtesy of M. Simon and Dr L. Berland of the Museum National D'Histoire Naturelle at Paris, I have been permitted to examine the type of Maypacius floridanus and to compare it with immature specimens of the same size from Alabama and Georgia. I am convinced that it is the same as Thomisus tenuis Hentz.[1] In Simon's definition of the genus Maypacius, of which M. vittiger Simon is the type, it is stated, "Chelarum margo inferior tantum bidentatus" (Hist. Nat., 2:293). In the type specimen of M. floridanus, however, and in several specimens from Alabama and Georgia compared with the type, there are three teeth. Simon also states: "Oculi quatuor medii inter se subaequales et aream longiorem quam latiorem occupantes;" but in his specimen and mine this area is considerably broader posteriorly than long.

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[1] Bost. Jour. Nat. Hist., 1847, 5:449, pl. 23, fig. 12
Proc. Bost. Soc. Nat. Hist., 1868, 11:106, figs. 84, 101.

Maypacius vittiger Simon is an African species and has been reexamined at my request by M. Louis Fage of the Paris Museum. In this species there are but two teeth on the lower margin of the furrow of the chelicera and the area of the four median eyes is longer than wide. M. floridanus therefore, can not be regarded as congeneric with Maypacius vittiger and is transferred to the genus Thanatidius.

Habits. Nothing is known of the habits of this species except that the female is mature in June in the Okefinokee swamp, Georgia.

Distribution. *Florida, *Billy's island, Okefinokee swamp, Ga.; *Holt, Tuscaloosa county, *Epes, Sumter county, Ala.; *Baton Rouge, La.

PELOPATIS nov. gen.

Generic characters. *Cephalothorax* considerably longer than broad, depressed. *Eyes* in four rows; total area of eyes slightly broader than long; line of anterior lateral eyes (first row) at least twice as wide as line of posterior median eyes (third row); almost as wide as line of posterior lateral eyes (fourth row) pl. 4, fig. 2; area outlined by four anterior eyes almost 3 times as broad anteriorly as long. Median ocular area very slightly broader posteriorly than long or equal. *Abdomen* long and slender with a median, basal, lanceolate spot, on each side of which near the middle of its length, is a small, black spot. Lower margin of the furrow of the chelicera with three teeth (pl. 4, fig. 4). *Legs* 1-4-2-3; tibiae of first and second legs beneath with 2-2-2-2-2 spines, four pairs extremely long and overlapping; apical pair reduced and sometimes missing; metatarsi of first and second legs beneath with 2-2-2-2 spines; apical pair short. *Sternum* longer than broad, produced posteriorly between coxae of fourth legs.

Type. Tetragonophthalma undulata Keyserling

Thanatidius[1] Pickard-Cambridge, Proc. Zool. Soc. London, 1903, *73*:156
Thanatidius Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 54
Thanatidius Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, *29*:547
Thanatidius Comstock, The Spider Book, N. Y., 1912, p. 605

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[1] F. Pickard-Cambridge (Proc. Zool. Soc. London, 1903) questioned the identity of Thanatidius in note 2, p. 153, as follows: "One can not be quite certain that Thanatidius has been correctly identified." On page 156, the description of the eyes of Thanatidius spinipes makes it appear that the anterior row is much wider than the posterior. The description refers to the figure (pl. 14, fig. 10) which is apparently reversed on the plate. When turned right side up, the eyes appear as they are in Pelopatis undulata (Keyserling).

Pelopatis undulata (Keyserling)

Verh. Zool. Bot. Ges. Wien., 1887, 37:486, pl. 6, fig. 42

Type. Tetragonopthalma undulata Keyserling; type specimen not known to exist

Type locality: Archer, Fla. (Marx collection)

Female (alcohol). Length 11-19mm; legs, 1-4-2-3; pl. 3, fig. 1; pl. 4, figs. 2-5

Cephalothorax above dull yellow sparsely clothed with yellowish brown hairs; on the disk, two irregular bands slightly darker, separated by the dorsal groove and a narrow, dark line extending from groove to posterior median eyes; a narrow, sub-marginal, dark line along sides of thorax to cervical groove. *Eyes* almost equal in size; posterior lateral slightly larger and anterior lateral perhaps smaller; four anterior eyes form a triangular area over twice as wide anteriorly as long; first row (anterior lateral) much wider than third row (posterior median). *Clypeus* very narrow, scarcely the width of an anterior median eye; seen from above, the anterior lateral eyes appear to project from anterior margin of head. *Chelicera* in color like cephalothorax and with mixed short and long hairs; lower margin of the furrow with three teeth (pl. 4, fig. 4). *Abdomen* above yellowish white; a median dusky band with edges gently scalloped extends to spinnerets; through centre of dusky band at base, a lanceolate mark and on each side of this a black dot; venter of abdomen behind genital furrow pale yellow. *Legs* light yellowish brown, lighter beneath; unmarked except for dark spots at base of spines. *Sternum*, labium and endites pale yellow. *Epigynum* resembles that of Thanatidius tenuis Hentz and Pisaurina mira.

Male: length 9-14 mm; legs 1-4-2-3; pl. 3, fig. 2; pl. 4, fig. 1. The male resembles the female in color but the abdomen and legs are proportionally longer and more slender. The abdomen above has the median scalloped band only slightly developed or absent but the basal lanceolate mark is usually evident with its accompanying black spots. The palpus (pl. 4, fig. 1) resembles that of Pisaurina mira; the tibia however, is longer and slimmer and has the apophysis shorter and directed forward.

Mature males are in the collections at Cornell University and the Museum of Comparative Zoology, Cambridge, Mass.

Synonymy

Tetragonophthalma undulata Keyserling, Verh. Zool. Bot. Ges. Wien., 1887, 37:486, pl. 6, fig. 42

Tetragonophthalma undulata, Marx, Proc. U. S. Nat. Mus. 1890, 12:567

Tetragonophthalma dubia, Banks, Proc. Ent. Soc. Wash., 1899. 4:188, 190

Thanatidius dubius, Banks, Proc. Acad. Nat. Sci. Phila., 1904. 56: 136

Thanatidius dubius, Banks, Second Rep't. Sec'y de Agricultura Comercio y Trabajo de la Republica de Cuba, 1909, pt 2, p 166

Thanatidius dubius, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 54

Thanatidius dubius, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:547

Thanatidius dubius, Rosenfeld, Jour. Econ. Ent., 1911, 4:404

Thanatidius dubius, Comstock, The Spider Book, N. Y., 1912, pp. 605-606, fig. 690

Thanatidius dubius, Lutz, Ann. N. Y. Acad. Sci. 1915, 26:101

Remarks. Simon[1] properly characterized this genus under the name Thanatidius but selected as the type, Thomisus dubius Hentz. It is evident, therefore, that Simon had before him a specimen of the earlier described Tetragonophthalma undulata of Keyserling when he gave his diagnosis.

Habits. Specimens from the Okefinokee swamp in Georgia were collected in the low ground bordering the islands. A mature male was taken in May 1912 and a mature female in June of the same year.

Distribution. ***Denmark**, S. C.; *Billy's island, Okefinokee swamp, *Waycross and *Fargo, Ga.; Punta Gorda, *Miami, Archer, Fla.; Mensura and Shreveport, La.; Havana, Cuba.

PISAURINA Simon

Hist. Nat. Araignées, 1898, 2:295

The genus Pisaurina, proposed by Simon to include Dolomedes mirus Walckenaer (type), and those species of Hentz described under the name Micrommata (M. undata, M. serrata, M. carolinensis), was characterized as follows: anterior row of eyes in a slightly procurved line, median larger than lateral; median ocular area slightly longer than broad posteriorly; posterior median somewhat larger than anterior median. Careful measurements of a considerable number of individuals of both sexes, however, show the median ocular area is as wide posteriorly (a little wider in some) as long, and that the eyes of the anterior row are equal in size and equidistant.

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[1] Hist. Nat. Araignées, 1898, 2:203

Cephalothorax slightly longer than broad, constricted in front of cervical grooves. *Eyes* in two rows (pl. 9, fig. 4); anterior slightly procurved, posterior strongly recurved; median ocular area as wide, or slightly wider posteriorly than long; eyes of the anterior row equal in size and equidistant. Lower margin of furrow of chelicera with three teeth (pl. 9, fig. 3). *Abdomen* about twice as long as broad. *Legs:* First, second and fourth longest, about equal; third shortest; tibiae and metatarsi of first and second legs beneath, with 2-2-2-2 spines, apical short; superior lorum of the pedicle with a transverse suture (pl. 9, fig. 2).

Type of the genus Dolomedes mirus Walckenaer.

Pisaurina Simon, Hist. Nat. Araignées, 2d ed., 1898, 2:295
Ocyale Emerton, Tran. Conn. Acad., 1885, 6:499-500
Pisaurina Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 54
Pisaurina Petrunkevitch, Bul. Amer. Mus. Nat. Hist. 1911, 29:545
Pisaurina Comstock, The Spider Book, N. Y., 1912, p. 607

Key to Species

Median dorsal stripe of abdomen above, when present, with sides more or less notched; first leg without femur and basal segments, as long as body. Pisaurina mira (Walckenaer)

Median dorsal stripe of abdomen above with sides nearly straight and bordered each side by a bright white line; first leg without the femur and basal segments, shorter than the body Pisaurina brevipes (Emerton).

Pisaurina mira (Walckenaer)

Hist. Nat. Ins. Apt., 1837, 1:357

Type: Dolomedes mirus Walckenaer; type specimen not known to exist

Type locality: Georgia
Female: Length 13-16.5mm; average of ten, 14.4mm; legs 1-2-4 about equal, third shortest; pl. 5, fig. 1; pl. 8, fig. 3; pl. 9, figs. 2-5; pl. 11

Cephalothorax above with ground color light yellow to light brown on the sides and with a median band, dark brown, tapering slightly from clypeus to posterior margin of cephalothorax; median band inclosing the eyes and occupying about one-third of the entire width of the thorax; extreme margin of thorax often with a narrow, dark line; sides diffused with dusky; bordering the median band, often a line of white hairs; the median band clothed with brown hairs and in the eye region, long, white ones. In life or dry, the sides appear covered with dirty white hairs and the color of the integument is obscured. *Eyes* surrounded with black (pl. 9, fig. 4); eyes of anterior row in a slightly procurved line, practically equal in size and equi-distant, separated by a little less than the diameter of one of them; posterior row strongly recurved, eyes equal in size and larger than those of anterior row; median separated by the diameter of one of them, considerably farther from the lateral; area of median eyes as broad posteriorly as long. Width of clypeus about 2½ diameters of an anterior median eye. *Chelicera* yellowish brown clothed with long, white hairs, some of which are dark on basal third; lower margin of the furrow with three teeth. *Abdomen* above with a dark median band clothed with light brown hairs; anteriorly as broad as that of cephalothorax, gradually widening to the middle of the length of abdomen, then, the sides becoming notched, tapering to spinnerets. Contrast between median band and the lighter integument of sides heightened by dense covering of white hairs on the latter in life or when dry; several oblique rows of small, often indistinct, brown spots cross sides of abdomen and terminate indefinitely at sides of venter. Below abdomen is dirty yellowish white spotted more or less with brown; often a median, light line from epigynum to spinnerets. Integument of legs brownish yellow, in life considerably lighter from covering of mixed white and light brown hairs. In some specimens otherwise typically colored the legs are strongly banded. *Sternum* lighter than legs; a median yellow mark with irregular sides is bordered with gray. *Labium* reddish brown at base, lighter distally; endites usually pale yellow. *Epigynum* (pl. 9, fig. 5): lateral lobes separated anteriorly, meet on the middle line behind; median lobe excavated in front.

Male: length 12-15 mm; legs (1-2)-4-3: 38-38-35-31 mm; frontispiece; pl. 5, fig. 2; pl. 9, fig. 1

Color and pattern in general like that of female; in size a little smaller with abdomen less robust. Legs considerably longer and more slender than in female. The external apophysis of the tibia of the palpus is truncated and concave on its inner surface. The bulb resembles that of Pelopatis undulata but differs markedly from other genera of the family.

Very young specimens are pale green or yellow with a pair of dark longitudinal stripes on the cephalothorax.

Dark variety. Pl. 6, fig. 2; pl. 8, figs. 2, 4.

In this variety the median band of the cephalothorax is not as well marked as in the typical form, being obscured by a covering of short, white hairs. The integument of the sides is darker but in life the covering of white hairs gives a grayish appearance to the entire cephalothorax. On the abdomen the median band may be almost obliterated or indicated by small dense patches of white hair in spots that correspond to lateral notches in the band of a normally marked individual. The legs may be uniform brown or more or less ringed.

Variety subinflata. Pl. 7, fig. 1; pl. 9, fig. 6

Under the name Micrommata subinflata, Hentz described this variety of Pisaurina mira as a distinct species; but there are no constant structural characters to distinguish it although its color pattern may show wide divergence from the form described as typical; moreover, in its distribution it is coincident with the other varieties.

The median band of the cephalothorax is narrowly constricted in the region of the dorsal groove or present as a dusky stripe. Lateral margins of cephalothorax with a dark line sometimes broken into spots. Median band of abdomen considerably reduced; widest in front, narrowing to linelike proportions posteriorly or broken, forming angulate spots. Lateral oblique rows of spots intensified and more conspicuous than in typical variety. Legs conspicuously ringed with black or brownish black on distal ends of femora, tibiae and metatarsi; patellae all dark. The epigynum may differ slightly from that of P. mira but the variation is not greater than that which occurs in a series of the typical form.

Synonymy

Dolomedes mirus Walckenaer, Ins. Apt., 1837, 1:357
Dolomedes virgatus Walckenaer, ibid., p. 358
Micrommata undata Htz., Bost. Jour. Nat. Hist., 1847, 5:192-193, pl. 16, fig. 7
Micrommata serrata Htz., ibid., p. 193, pl. 16, fig. 8
Micrommata marmorata Htz., ibid., pp. 193-104, pl. 17, fig. 5
Micrommata carolinensis Htz., ibid., p. 104, pl. 16, fig. 9
Micrommata subinflata Htz., Bost. Jour. Nat. Hist., 1850, 6:288, pl. 10, fig. 13
Micrommata carolinensis, Scudder, Scudder's Supplement, Proc. Bost. Soc. Nat. Hist., 1868, 11:103
Micrommata subinflata Htz., ibid., p. 104
Micrommata marmorata ibid., p. 104, figs. 56, 105
Micrommata serrata ibid., p. 104, fig. 1
Micrommata undata ibid., p. 104, fig. 98
Micrommata undata Burgess, Reprint, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, pp. 42-43, pl. 6, fig. 7; pl. 18, fig. 98
Micrommata serrata, ibid., p. 43, pl. 6, fig. 8; pl. 18, fig. 1
Micrommata marmorata, ibid., p. 44, pl. 7, fig. 5; pl. 18, fig. 56, 105
Micrommata carolinensis, ibid., pp. 44-45, pl. 6, fig. 9; pl. 20, fig. *4a-b-c.*
Micrommata subinflata Htz., ibid., p. 161, pl. 17, fig. 13
Ocyale undata, Emerton, Tran. Conn. Acad., 1885, 6:499-500, pl. 49, figs. *7, 7a*
Ocyale undata, Marx, Proc. Nat. Mus., 1890, 12:565
Ocyale undata, Stone, Proc. Acad. Nat. Sci. Phila., 1891, 42:432
Ocyale undata, Marx, Proc. Ent. Soc. Wash., 1892, 2:160
Ocyale undata, Banks, Proc. Acad. Nat. Sci. Phila., 1892, 43:72
Ocyale undata, Baker, Ent. News, 1894, 5:164
Pisaurina undata, Banks, Ent. News, 1895, 6:206
Pisaura undata, Banks, Jour. N. Y. Ent. Soc., 1895, 3:91
Pisaurina mira, Simon, Hist. Nat. des Araignées, 2d ed., 1898, 2:295
Ocyale undata, Slosson, Jour. N. Y. Ent. Soc., 1898, 6:248

Ocyale undata, Banks, Proc. Ent. Soc. Wash., 1899, 4:190

Pisaurina undata, Banks, Proc. Acad. Nat. Sci. Phila., 1900, 52:537

Ocyale undata, Emerton, Common Spiders, 1902, p. 88, figs. 215–217

Ocyale undata, Montgomery, Proc. Acad. Nat. Sci. Phila., 1902. 54:584–586

Ocyale undata, Britcher, Proc. Onon. Acad. Sci. 1903. 1:129

Ocyale undata, Montgomery, Proc. Acad. Nat. Sci. Phila., 1903. 55:91–92, pl. 4, fig. 1

Ocyale subinflata, Britcher, Proc. Onon. Acad. Sci., 1903, 1:129

Pisaurina mira, Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:320–321

Pisaurina undata, Banks, ibid., p. 136

Pisaurina mira, Schaeffer, Tran. Kan. Acad. Sci., 1905, 19:193

Pisaurina mira, Schaeffer, Kan. Univ. Sci. Bul., 1906, 3:119

Pisaurina undata, Banks, Ind. Dep't Geol. and Nat. Res. 31st Ann. Rep't, 1907. p. 743

Pisaurina subinflata, Banks, ibid.

Pisaurina mira, Bryant, Occ. Papers Bost. Soc. Nat. Hist., 7, 1908, p. 79

Pisaurina mira, Montgomery, Proc. Acad. Nat. Sci. Phila., 1909, 61:553–557

Pisaurina undata, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 54

Pisaurina subinflata, ibid.

Pisaurina undata, Banks, Proc. Acad. Nat. Sci. Phila., 1911, 63:452

Pisaurina mira, Petrunkevitch, Bul. Amer. Mus. Nat His., 1911, 29:545

Pisaurina subinflata, ibid.

Pisaurina mira, Comstock, The Spider Book, N. Y., 1912, p. 607, figs. 684–687, 691–692

Ocyale undata, Banks, Proc. Acad. Nat. Sci. Phila., 1916, 68:82

Pisaurina undata, Pratt, Manual Common Invertebrates, 1916, p. 432

Pisaurina undata, Barrows, Ohio Jour. Sci. 1918, 18:313

Remarks. The extreme variations to which this species is subject, both in size and coloration, have resulted in a multiplicity of names; but inasmuch as all varieties have the same range, none may be given subspecific value on the basis of geographic distribution. Hentz defined two groups (tribes) based on the arrangement of the eyes; in the first, the Arcuatae, the anterior row straight; in the second, the Biarcuatae, the anterior row procurved. Viewed from above, the first row may appear slightly recurved or straight but from in front, a slight procuvature is evident in all varieties. The names applied by Hentz to color varieties of this species follow: Micrommata undata, M. serrata, M. marmorata, M. carolinensis.

In Walckenaer's description, Dolomedes mirus is likened to Pisaura mirabilis of Europe, Africa, et al, a species totally unlike the Abbot drawing. It is evident, therefore, that Walckenaer had specimens before him when he wrote his account.

Habits. Overwintered specimens of all sizes and ages are found in the spring and some reach maturity and deposit their eggs as early as the last week of May or the first of June; thereafter mature specimens with eggs or young may be found throughout the summer and well into September. Farther south, mature males may be found in April. Low-growing vines and weeds at the edge of hillside woods offer favorable nursery sites for the early maturing individuals, especially where a southern exposure receives full benefit of the sun. Later in the season they are more widely scattered and are likely to be found on the bushes and low shrubs.

In the construction of the nursery web and disposition of the egg sac, Pisaurina mira differs widely from those species of Dolomedes whose habits have been observed. In the latter, the female carries the egg sac until the young are ready to emerge, then attaches it to a convenient support and spins the nursery web around it. With Pisaurina mira, the nursery is usually constructed before the eggs are laid. A plant having a three-lobed leaf is often selected for the retreat, and there seems to be a decided preference for the poison ivy (Rhus). The middle leaflet, pulled down and fastened, serves as a roof; the two lateral leaflets, as the side walls (pl. 10, fig. 1), and a silken platform spun across the opening beneath, as the floor (pl. 10, fig. 2). Hanging back downwards from the lines that hold the leaves in position, the spider clutches her sac of eggs with her chelicera and embraces it with the third legs. The first and second pairs partially encircle the sac but the claws are caught in the supporting strands of the nursery and serve with the fourth pair, to support the burden. Threads from the spinnerets complete the attachment behind and serve in emergency as the only connection. The egg sac, the size of a cherry pit and snowy white when first made, is enlarged considerably by the hatching and growth of the young and acquires a dingy hue.

Just before the eggs hatch, the sac is suspended in the retreat and the young, doubtless aided by the mother, escape through an opening in the bottom. To provide room—for the young moult once within the egg sac, soon after leaving it and again in about ten days—the silken floor of the chamber is pushed aside and new lines added which cover the outside and entangle nearby leaves (pl. 11). Females confined with their sacs proved their ability to construct dome-shaped retreats entirely of silk within which they remained until the young emerged. Another specimen provided with a paper leaf patterned after the poison ivy, drew the parts together in the conventional manner and hung with her sac for several days. In some cases several nurseries are constructed before one is found to meet the exact requirements and it is due to this habit that the female is sometimes found wandering about with her egg sac.

Montgomery[1] who made some observations on the care of the young, states that the spinnerets are not attached to the egg sac; but several specimens of mine when offered water were observed to drag the sac from the spinnerets alone in the same manner as a lycosid.

The actual mating of the species has not been observed by me but I was fortunate enough to watch the development of a male and find it preparing a web (see frontispiece) for the reception of the spermatic products. An immature male taken July 18th moulted August 16th, September 11th and again January 8th. On January 23d a small vertical web of fine lines suspended between coarser supports was spun across the glass chimney in which the male had been confined. On one side a little above the center, the spermatic fluid was deposited in a drop. A little later the male took his position on the other side of the web and applied the palpal organs alternately by reaching over the top and patting the drop with one palpus, the other meanwhile being raised to the level of the eyes. The procedure lasted but a few minutes, the drop diminishing visibly as each palpus touched it.

Distribution. Ottawa, Winnipeg, Canada; *Brittons, *Jamesville, *Baldwinsville, *Long Branch, *Fishkill Landing, *Ithaca, *Staten Island, *Bump's pond, *Otto, *Hyde Park, *Albany, *Rensselaer, *Flatbush, New York; *Gambier, *Urbana, *Columbus, *Rockbridge, Marietta, Delaware, Ohio; *Wood's Hole, Roxbury, Beverly, Topsfield, Peabody, Holyoke, Brookline, Mount Tom, Warwick, Mass; Franconia, Lake Winnepesaukee, N. H.; New Haven, Conn.; Philadelphia, Chester, Pa.; *Madison, *Vineland, N. J.; *Washtenaw county, Mich.; *St Croix Falls, Wis.; *Olney, *Riverside, New Lenox, Pistakee, Gangers, Ill.; *Lawrence county, Wild Cat creek, Kan.; Arlington, Bass Lake, Shoals, Culver, Greencastle, Otis, Porter, Huntington, Ind., *Great Falls, *Dyke, *Black pond, *Potomac river, *Falls Church, Va.; *Millville, W. Va.; *De'escarlia Reservoir, *Cabin John, *Beltsville, *Island creek, *Hyattsville, *Little Paint Branch, *Forest Glen, Md.; *District of Columbia; Delaware; *Chapel Hill, Morgantown, Murphy, Swannanoa Valley, Black Mountains, N. C.; *Charleston, S. C.; *Chastine, Shreveport, La.; *Starkville, *Sessums, Miss.; Opelika, *University, *Pratt's Ferry, *Woodstock, *Hull lake, *Holt, Ala.; *Springfield, Mo.; *Punta Gorda, Fla.; Texas; Georgia.

Variety subinflata. This variety is apparently not so common as the others but is widely distributed. Specimens have been examined from Chatham, Mass.; Onondaga valley, Baldwinsville, Pagan Hill, Indian Reservation, Onondaga county, Ithaca, Riders Mills, Columbia county, N. Y.; St Croix Falls, Wis.; Anacostia, D. C.; also reported from Alabama.

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[1] Proc. Acad. Nat. Sci. Phila., 1903, p. 91.

Pisaurina brevipes (Emerton)

Tran. Conn. Acad. Arts and Sci., 1911, 16:400, pl. 4, figs. 6, 6a

Type: Pisaura brevipes Emerton; type specimen in collection of Museum of Comparative Zoology, Cambridge, Mass.

Type locality: Mount Tom, Mass., South Framingham, Mass.

Female (alcohol): length 11mm; legs, 4-(1-2)-3; 18-16-16-14.5mm; pl. 7, fig. 2; pl. 33, fig. 5.

Cephalothorax above with a broad, dark reddish brown median stripe extending from the clypeus to posterior margin of thorax; on each side of this a whitish or yellowish brown band, narrowing to a point at the sides of the clypeus but rapidly widening to one-half the width of the median band; sides below light band, dark reddish brown. Light stripes in integument clothed with white hairs, dark bands with mixed white and brown hairs. *Eyes* of anterior row in a slightly procurved line, equal in size and equidistant, separated by less than the diameter of one of them; posterior median a little larger than anterior median; median ocular area as broad or a little broader posteriorly, than long. Height of *clypeus* less than one-half that of median ocular area. *Chelicera* light brown clothed with long and short, white and yellowish hairs; lower margin of the furrow, armed with three evenly spaced teeth. *Abdomen* above with a median stripe continuing that of the cephalothorax and anteriorly of the same color; posteriorly deep brown (in some, almost black) and slightly tapering; sides of median band with fewer undulations than is the case in P. mira; on each side of median band a line of dense, white hairs below which the integument, light yellow brown, is covered sparsely with white hairs; sides and venter brown with a covering of fine yellowish or white hairs. *Legs* fourth longest, first and second about equal, third shortest; uniform reddish brown except coxae beneath which are spotted with black. *Sternum* dark brown with lighter median stripe. *Labium* light brown at base, paler distally; endites light brown, pale on side bordering labium. *Epigynum* a little shorter and rounder than in Pisaurina mira.

Male: The male has not been described.

Synonymy

Pisaura brevipes Emerton, Trans. Conn. Acad. Arts and Sci., 1911, 16:400, pl. 4, figs. 6, 6a.
Pisaura brevipes, Barrows, Ohio Jour. Sci., 1918, 18:313
Pisaura brevipes Emerton, Trans. Royal Can. Inst., 1919, 12:327

Remarks. I have transferred this species from the genus Pisaura because the eyes, epigynum and clypeus resemble Pisaurina mira, the type of the genus. In Simon's definition of the genus Pisaura, it is pointed out that the height of the clypeus equals or exceeds that of the median ocular area, that the posterior median eyes are one-third larger than the anterior eyes and that the posterior eyes are equal in size. In a specimen of this species kindly loaned me by Mr J. H. Emerton, I find the height of the clypeus less than one-half the height of the median ocular area, the posterior median eyes only a little larger than the anterior median, characters which are also found in Pisaurina mira. Furthermore the suture of the lorum of the pedicle resembles closely that of Pisaurina.

In general this species is a little smaller than P. mira with strongly contrasting colors and legs proportionally shorter and stouter. Nothing has been published concerning its habits.

Known distribution. Mount Tom, *South Framingham, Mass.; Vineland, Ont., Canada; Sugar Grove, *Ashtabula, Ohio; *Washtenaw county, Mich.

DOLOMEDES Latreille

Nouv. Dict. Hist. Nat., 1804, 24:135

The genus Dolomedes was established by Latreille without direct indication of the species which he considered belonged in it. He did, however, indicate that it was equivalent to the " Coureuses " of Walckenaer. The only paper of Walckenaer to which he could have referred was the " Faune Parisienne " 1802, in which (v. 2, p. 235 under, "fam. 14. coureuses") he includes two species, Aranea mirabilis and Aranea marginata. It has been clearly established by T. Thorell[1] and others that D. marginatus is the same as D. fimbriatus. This leaves only D. mirabilis and D. fimbriatus to be considered in determining the type of the genus.

In 1805, Walckenaer[2] adopted the genus Dolomedes and placed in it four species which he divided into two " families," the Ripurariae and the Sylvariae. In the first he placed D. marginatus De

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[1] Recensio Critica Aran. Suecic., 1856, p. 66.
Remarks on Synonyms of European Spiders, 1872, pp. 346–349.

[2] Tableau des Araneides, 1805, pp. 16–17.

Geer (= D. fimbriatus), D. fimbriatus Clerck, and D. rufus De Geer; in the second, D. mirabilis Clerck. In 1837 C. L. Koch[1] following Sundevall 1832[2], placed D. mirabilis in the genus Ocyale, (now in Pisaura) and it is therefore evident that D. fimbriatus of Clerck[3] is the type of Dolomedes as indicated by Thorell.

Generic characters. *Cephalothorax* slightly longer than broad, high and convex in the eye region, somewhat flattened on the disk, and provided with a definite dorsal groove and less distinctly marked radical furrows; posterior declivity broad and steep. *Eyes* in two rows, (pl. 21, fig. 4) those of the posterior larger, usually about equal in size (when unequal, the posterior median slightly smaller and closer to each other than to the lateral) and equidistant. Anterior row usually slightly recurved with the median larger than lateral (rarely with anterior row straight and eyes subequal in size). Median ocular area a little wider posteriorly than long and much narrower in front than behind. *Clypeus* as wide or wider than the height of the median ocular area. Lower margin of the furrow of the chelicera with four teeth (pl. 21, fig. 3). *Legs* strongly developed, usually 4-1-2-3, third shortest, the others almost equal in length; tibiae and metatarsi of first and second legs below, armed with 2-2-2-2 and 2-2-1 spines, respectively. Anterior segment of the superior lorum of the pedicle notched behind to receive a projection of the posterior segment (pl. 21, fig. 5).

Type of the genus, Araneus fimbriatus Clerck.

Dolomedes Latreille, P. A. Nouv. Dict. Hist. Nat., 1804, 24:135
Dolomede Walckenaer, Tab. des Aran., 1805, pp. 16–17
Dolomedes Latreille, Considerations generales sur l'ordere naturel des animaux composant les classes des Crustaces, des Arachnides, et des Insectes, Paris, 1810, p. 129
Dolomedes Sundevall, J., Genera Araneidum Sueciae exhibens, 1823, p. 20
Dolomede Latreille, P. A., Familles Naturelles du Regne Animal, 1825, p. 316
Dolomedes Latreille, Cours d'Entomologie, ou de l'Histoire naturelle des Crustaces, des Arachnides, des Myriapodes et des Insectes, Paris, 1831, pp. 536–537
Dolomedes Walckenaer, Hist. Nat. des. Ins. Apt., 1837, 1:345
Dolomedes Koch, C. L., Uebersicht des Arachnidensystems, 1837, 1:23
Dolomedes Hentz, Bost. Jour. Nat. Hist., 1846, 4:394
Dolomedes Thorell, T. Recensio Critica Aranearum Suecicarum, 1856, p. 66
Dolomedes Westring, N., Araneae Suecicae, 1861, pp. 534–536
Dolomedes Blackwall, Spiders of Great Britain and Ireland, 1861, 1:37
Dolomedes Simon, Hist. Nat. des Araignées, 1st ed., Paris, 1864, p. 374
Dolomedes Thorell, On European Spiders, Upsala, 1869, p. 194
Dolomedes Thorell, Remarks on Synonyms of European Spiders, 1872, pp. 346–349

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[1] Uebersicht des Arachnidensystems, 1837, 1:23.

[2] Sv. Spindl. Beskr. in Vet. Akad. Handl., 1832, p. 108.

[3] Aranei Suecici, Stockholm, 1757, pp. 106–108, pl. 5, tab. 9.

Dolomedes	Hentz, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 36
Dolomedes	Simon, Les Arachnides de France, Paris, 1876, 3:228-232
Dolomedes	Emerton, Trans. Conn. Acad., 1885, 6:300
Dolomedes	Stone, Proc. Acad. Nat. Sci. Phila., 1890, 42:432-433
Dolomedes	Marx, Proc. U. S. Nat. Mus., 1890, 12:566
Dolomedes	Simon, Hist. Nat. des Araignées, 2d ed., Paris, 1897, 2:312
Dolomedes	Montgomery, Proc. Acad. Nat. Sci. Phila., 1902, 54:586
Dolomedes	Comstock, A Classification of N. Amer. Spiders, 1903, p. 50
Dolomedes	Banks, Amer. Nat., 1905, 39:318
Dolomedes	Banks, U. S. Nat. Mus. Bul., 72, 1910, p. 53
Dolomedes	Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:511
Dolomedes	Comstock, The Spider Book, 1912, pp. 607-617

Key to the Species of Dolomedes[1]

Females

A Median lobe of epigynum hemispherical; as broad or broader than long

B Lateral lobes of epigynum narrow, scarcely meeting on middle line behind D. okefinokensis nov. sp. p. 38

BB Lateral lobes wide, broadly in contact on middle line behind D. tenebrosus Hentz p. 40

AA Median lobe of epigynum not hemispherical; considerably longer than broad

B Abdomen above dark reddish brown without lateral, light bands or markings; cephalothorax with a broad, submarginal, white band D. albiclavius nov. sp. p. 56

BB Abdomen above variously marked but not uniform dark reddish brown without lateral light bands or markings

C Abdomen above with several pairs of small, white dots in two rows

D Cephalothorax above with a submarginal band of bright white hairs; sternum with six small, black spots, three on each side near the coxae D. triton (Walckenaer) p. 50

DD Cephalothorax above without a submarginal band of bright white hairs; a pair of black, wedge-shaped marks in front of dorsal groove D. urinator Hentz, p. 36

CC Abdomen above without small, white spots arranged in two rows

D Abdomen above uniform dark brown bordered each side by white or yellowish white

E Lateral light bands of abdomen broad with two short branches extending towards the disk D. vittatus Walckenaer p. 47

EE Lateral light bands narrow, without branches D. striatus Giebel p. 57

DD Abdomen above not uniform dark brown bordered with white

E Abdomen above yellowish white or yellow marked with brown or black

F Abdomen above with a median, basal, black-edged mark of yellow followed by three rows of irregular, black spots D. fulviatronotatus nov. sp. 50

FF Abdomen above without a median, basal, black-edged mark of yellow; venter of abdomen with a median, light stripe from epigynum to spinnerets D. albineus Hentz p. 33

EE Abdomen above not yellowish white or yellow marked with brown or black

F Abdomen above dark brown; posterior half crossed by several transverse, W-shaped, white lines D. scriptus Hentz p. 44

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[1] Dolomedes pinicola is not included in the key which is based largely on the structure of epigyna. The only known specimen is immature p. 60

The males of but six of the eleven species of Dolomedes described herein are known; these resemble the females in color and markings except that the pattern is often more highly developed. The males of D. tenebrosus, D. okefinokensis and D. triton are considerably smaller than the females; they reach maturity earlier in the season and often escape detection when the females are conspicuous. Males of D. scriptus, D. albineus, and D. vittatus have smaller abdomens, but the legs are proportionally and sometimes actually longer than in the females.

Key to the Species of Dolomedes

Males

A A spinose hump on the femur of the fourth leg beneath
  B Tibial apophysis very long, extending almost one-half the length of the bulb D. triton Walckenaer p. 50
  BB Tibial apophysis short, extending only to base of bulb D. vittatus Walckenaer p. 47
AA No spinose hump on the femur of the fourth leg beneath
  B Median apophysis of bulb stout, small at base, dilated distally, produced to a point on the side toward tip of embolus
    C Apophysis of tibia short, concave internally, broadly notched at tip; venter of abdomen with a definite median, light stripe from genital furrow to spinnerets; abdomen above white or grayish white marked with light brown D. albineus Hentz p. 33
    CC Apophysis of tibia broadly dilated and deeply notched distally; venter of abdomen without a definite median light stripe; abdomen above crossed by several transverse W-shaped white lines D. scriptus Hentz p. 44
  BB Median apophysis of bulb slender; distal half narrow, ribbon-like, almost transparent
    C Median apophysis acutely angled at middle of its length; basal half abruptly swollen in the middle D. tenebrosus Hentz p. 40
    CC Median apophysis nearly right-angled at middle of its length; basal half not conspicuously swollen D. okefinokensis nov. sp. p. 38

Dolomedes albineus Hentz

Bost. Jour. Nat. Hist. 1845, 5:189–190, pl. 16, fig. 2

Type: Dolomedes albineus Hentz; type specimen not known to exist
Type locality: Alabama
Female (alcohol): length 20-28mm; average 24mm; legs 4-1-2-3, 51-48-47-41mm; pl. 12; pl. 14, figs. 2-3

Cephalothorax above, light reddish or yellowish brown, dorsal and radial grooves darker and bearing brown hairs; scattered patches of short, white hairs, indistinct in alcohol, between radial grooves; extreme margin black; head slightly darker, somewhat elevated, sides thickly clothed with short, white hairs. *Eyes* of the anterior row in a slightly recurved line, median somewhat larger than the lateral and closer to them than to each other; posterior row strongly recurved, eyes subequal in size and with a diameter one and one-half that of the anterior median; posterior median separated by less than the diameter of one of them, a little farther from the lateral. Upper half of clypeus with a band of short, white hairs connecting white patches on sides of head; lower margin of clypeus dark reddish brown clothed with short, brown hairs. *Chelicera* dark reddish brown to black, sides and distal end with long, white hairs. *Abdomen* above with ground color light yellow; a median band of brown, narrow anteriorly but widened abruptly about the middle of the length of the abdomen, is clothed with short, white and brown hairs; behind middle, the median band is twice constricted; sides of abdomen grayish; venter with a black-bordered median light yellowish white band widest anteriorly and tapering from epigastric furrow to spinnerets. Spinnerets reddish. *Legs* yellowish or reddish brown mottled with patches of brown and white hairs; coxae reddish brown. *Sternum* reddish brown clothed with mixed white pubescence and long, dark hairs. *Labium* and endites dark reddish brown, lighter distally. *Epigynum:* the lateral lobes unite in front of the median lobe and are barely separated behind; median lobe widest in front, tapering to a blunt point behind.

Male (alcohol): Length, 16-17mm; legs, 1-2-4-3, 49-46-45-33mm; pl. 13; pl. 14, fig. 1.

Cephalothorax and abdomen above marked as in female. Legs proportionally longer, much lighter colored and indistinctly blotched with long, brown hair on femora, patellae, and tibiae; below, coxae and femora immaculate, dingy yellow; joints beyond, darker; fourth pair longer than first. Sternum, endites and labium light yellow; abdomen beneath with a light median stripe bordered with brown; sides of abdomen below, yellow. Tibia of palpus with a bunch of strong spines on the distal end beneath; external apophysis broad, concave internally and truncated at tip; a broad, rounded tooth at the base of apophysis on anterior side.

Synonymy

Dolomedes albineus Hentz, Bost. Jour. Nat. Hist., 1845, 5:189–190, pl. 16, fig. 2 (female)

Dolomedes albineus Hentz, Scudder, Proc. Bost. Soc. Nat. Hist., 1868, 11:103, fig. 73

Dolomedes albineus Hentz, Reprint, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 39, pl. 6, fig. 2; pl. 18, fig. 73

Dolomedes albineus, Banks, Ent. News, 1898, 9:142

Dolomedes albineus, Marx, Proc. Nat. Mus., 1899, 12:566

Dolomedes albineus, Banks, Proc. Nat. Sci. Phila. 1901, 52: 530, 538

Dolomedes albineus, Banks, Proc. Acad. Nat. Sci. Phila., 1904, 56:136

Dolomedes albineus, Banks, Bul. 72, U. S. Nat. Mus., 1910, p. 53

Dolomedes albineus, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:542. Considered by Petrunkevitch as a synonym of Dolomedes rufus De Geer

Dolomedes albineus, Comstock, The Spider Book, New York, 1912, p. 609

Remarks. Dolomedes albineus Hentz is regarded by Banks[1] and Petrunkevitch[2] as a synonym of Dolomedes rufus De Geer. Simon[3] in his discussion of D. rufus, listed D. tenebrosus Hentz as a synonym but figured, apparently following Emerton[4], the tibial apophysis of D. vittatus Walckenaer[5]. But there is nothing in De Geer's[6] description or figure of Dolomedes rufus (*Aranea rufa*) to enable this species to be specifically identified with any of the American forms now recognized. De Geer's specimen came from Pennsylvania, a locality much too far north for this distinctly southern species. Walckenaer[7], following De Geer, described two specimens from Georgia, compared them with Abbot's plates of the "Tree Spider," and indicated their identity with De Geer's D. rufus. Abbott's figures[8] were thought by Walckenaer to represent variations of a single species and this is possibly true, although it is impossible to determine which one. Two of the four drawings bear no resemblance to any known American species; the others may be said to approach D. scriptus Hentz and D. albineus Hentz. Neither is well enough defined to be placed with any degree of certainty.

C. Koch[9] described and figured specimens from Pennsylvania and Georgia, using the name Ocyale rufa and listing De Geer's and Walckenaer's names as synonyms. While there is a slight resemblance between the Koch figure and one of Abbot's, neither shows the distinctive pattern of Dolomedes albineus; in fact, Koch's figure is more nearly like D. scriptus or D. tenebrosus; but in this case, the species of Koch and Walckenaer must be disregarded, even if recognizable, for they were assumed to be identical with the indeterminable species of De Geer.

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[1] Banks, Ent. News, 1898, 9:142.

[2] Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:541-542.

[3] Simon, Hist. Nat. des Araignées, 2d ed., 1898, 2:302, fig. 300*a*

[4] Emerton, Tran. Conn. Acad., 1885, 6:501, pl. 49, fig. 9*b*.

[5] Emerton in his early account of Dolomedes tenebrosus figured the palpal organ and tibial apophysis of D. vittatus (D. lanceolatus Hentz). In a later paper, Tran. Conn. Acad., 1900, 14:211, under the discussion of D. urinator, he points out that his male "appears to be urinator or lanceolatus, Hentz." D. urinator is now known to be a distinct species, not the male of D. vittatus (D. lanceolatus).

[6] De Geer, Mem. L'Hist. des Insectes, 1778, 7:319-320, pl. 30, figs. 6-7.

[7] Walckenaer, Ins. Apt., 1837, 1:351.

[8] Abbot, Georgia Spiders, pl. 1, fig. 1; pl. 2, fig. 6; pl. 4, fig. 16; pl. 57, fig. 281.

[9] C. Koch, Die Arachniden, 1848, 14:112, pl. 483, fig. 1340 female).

Habits. The low river and coastal swamps of the southeast are the localities in which the greatest numbers occur. The neutral ash-gray color of the living spiders and their habit of resting motionless and head downward on the trunks of cypress and tupelo gums, render them almost invisible. When disturbed, they rush into the water or dodge with surprising quickness to the opposite side of the tree, after the manner of a squirrel. The typical habitat of the species is shown in the accompanying plate (pl. 15). Females with egg sacs were found in July at Spring creek and in the Okefinokee swamp, Georgia.

Distribution. Auburn, *Mobile, *Wiluski Shoals, Shelby county, *Epes, Sumter county, *Silas, Choctaw county, Ala.; *Honey Island Prairie, *Floyd's island, *Billy's island, Okefinokee swamp; *Spring creek, Decator county, Ga.; *Biloxi, Miss.; Altoona, *Arkadelphia, Ark.

Dolomedes urinator Hentz

Bost. Jour. Nat. Hist., 1845, 5:190, pl. 16, fig. 3

Type: Dolomedes urinator Hentz; type specimen not known to exist

Type locality: "North Carolina, Alabama."

Female (alcohol): length, 20-28mm; average of seven mature specimens, 23.7mm; legs 4-2-1-3, 55-50-40-45mm; pl. 16; pl. 33, fig. 3

Cephalothorax above deep reddish brown, clothed with short, dark brown hair; extreme margin black; radial grooves darker, narrow above, expanding somewhat on the sides; in front of the dorsal groove, a pair of small, black, wedge-shaped marks, their apices directed backward; eye region black. *Eyes:* anterior row slightly recurved, median a little larger than lateral and closer to them than to each other; posterior row strongly recurved, eyes equal in size or nearly so, almost twice the diameter of anterior median; posterior median separated by less than the diameter of one of them, considerably more than their diameter from the lateral. Width of clypeus 4 to 5 times the diameter of an anterior median eye. *Chelicera* deep reddish brown to black, clothed with long hairs. *Abdomen* above and on sides, dark reddish brown with a dense covering of short, brown hairs; on basal third above, a lighter, median, lanceolate mark (sometimes absent); on posterior part four or five pairs of small, white spots surrounded by a narrow line of black (indistinct in alcohol), each pair connected by a short, recurved, black bar; venter of abdomen in some specimens, with a band somewhat lighter, tapering from epigastric furrow to spinnerets. *Legs* reddish brown, indistinctly blotched on femora; terminal segments darker. *Sternum* uniform dark brown, thickly haired. *Labium* and *endites* bright reddish brown, lighter distally. *Epigynum* considerably broader than long; median lobe concave anteriorly, convex on posterior half; lateral lobes barely separated behind (pl. 33, fig. 3).

Male unknown.

Synonymy

Dolomedes urinator Hentz, Bost. Jour. Nat. Hist., 1845, 5:190, pl. 16, fig. 3

Dolomedes urinator Hentz, Reprint, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 40, pl. 6, fig. 3

Dolomedes urinator, Marx, Proc. U. S. Nat. Mus., 1890, 12:566

Dolomedes urinator, Banks, Proc. Acad. Nat. Sci. Phila., 1892, 44:73

Dolomedes urinator, Banks, Proc. Acad. Nat. Sci. Phila., 1900, 52:536

Dolomedes urinator, Montgomery, Proc. Acad. Nat. Sci. Phila., 1902, 54:586–588, pl. 30, fig. 50. In part, described D. scriptus but figured epigynum of D. urinator

Dolomedes urinator, Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:317–319 (females, in part)

Dolomedes urinator, Banks, Bul. 72, U. S. Nat. Mus., 1910, p. 53

Dolomedes urinator, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:542 (in part)

Dolomedes urinator, Comstock, The Spider Book, N. Y., 1912, pp. 609, 611–612 (in part), figs. 699–700

Dolomedes urinator, Barrows, Ohio Jour. Sci., 1918 18:313

Remarks. Dolomedes urinator has been very generally regarded as the female of the species described by Hentz[1] under the name Dolomedes lanceolatus. This relationship, first suggested by Banks, was accepted by students of spiders as a natural one, since males in one case were unknown and females having the markings of D. lanceolatus had never been recorded. Now, however, the females of D. lanceolatus are known to resemble the males and the specific name of Walckenaer, Dolomedes vittatus, is applicable.

The list of references given above includes only those accounts which mention or describe the female. The male of D. urinator is unknown to me and I can find no description of it or record of its capture. It is, perhaps, like the male of Dolomedes tenebrosus, very much smaller than the female and earlier maturing; the females, however, are among the largest of our native species.

Habits. Concerning the habits of this species Hentz remarks: "This large species is found near water, on which it runs with great swiftness. When closely pursued, it dives under the surface, and conceals itself under some leaves or rubbish until danger is past." I have never found the nursery web of this species but it doubtless resembles that of related forms. The egg sac of a very large female was three-quarters of an inch in diameter and contained 1457 young; the shed skins representing at least one moult.

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[1] Bost. Jour. Nat. Hist., 1845, 5:190.

Dolomedes urinator is uncommon in the north but is fairly abundant in the latitude of Washington, D. C. and farther south.

Distribution. *Ithaca, *Jamaica, *Debruce, Sullivan county, N. Y.; *Hollis, N. H.; *West Chester, Pa.; Milton, Mass.; New Jersey; Rockbridge, New Lexington, Ohio; *Olney, Ill.; *Washington, *Chain Bridge, D. C.; *Cedar Grove, Md.; *Falls Church, *Blue Ridge mountains, *Capon Springs, Va.; North Carolina; *Bainbridge, Ga.; *Florida; *Auburn, Ala.; Austin, Texas.

Dolomedes okefinokensis nov.sp.

Type: a mature female, no. 9423 and allotype no. 9426, in collection of New York State Museum; paratypes in collection of Cornell University

Type locality: Billy's island, Okefinokee swamp, Georgia, June 1912, C. R. Crosby and S. C. Bishop collectors

Female (alcohol): length 30mm; legs 4-1-2-3; 63-59.5-58.5-52.5mm; pl. 17, pl. 19, fig. 2

Cephalothorax above reddish brown narrowly margined with black; back of the eyes, an oval area lighter brown inclosed on the sides by narrow, yellowish lines and limited posteriorly by a pair of dark brown, wedge-shaped patches which lie in front of the dorsal groove; radial furrows dark brown, their extremities on sides of thorax expanded to inclose an elongate yellowish white spot. Area of the eyes dark brown to black and bearing patches of short, white hair. *Eyes:* anterior row slightly recurved; the median, separated by less than the diameter of one of them, are a little larger than the lateral and nearer to them than to each other; posterior row strongly recurved; the median, separated by less than the diameter of one of them, are one-third larger than median of anterior row; posterior lateral largest, separated from the median by 3 times the radius of one of them. *Clypeus* dark brown clothed with short, white hairs on the front and a long fringe on the lower margin: width of clypeus about four times the diameter of an anterior median eye; *Chelicera* dark reddish brown clothed with long, yellowish white hairs. *Abdomen* above, dull brown; a light yellow, median stripe on the anterior half is bordered each side by a small crescent of the same color; posterior half of abdomen with a series of three or four chevrons, the lateral ends of which often inclose small, white spots as in D. tenebrosus; sides of abdomen usually uniform reddish brown but sometimes mottled; venter a little lighter. *Legs* brown above with soft yellowish brown pubescence, more or less annulate on the femora and tibiae; below, lighter, scopulate on metatarsi and tarsi. *Sternum* yellowish or reddish brown, often lighter mesally. *Labium* and *endites* dark reddish brown, lighter distally. *Epigynum* with the median lobe broadly convex; lateral lobes heavily chitinized on inner margins and scarcely meeting on middle line behind (pl. 19, fig. 2).

Male (alcohol): length 8mm; legs 4-1-2-3, 24.5-24-23.5-20.25mm; pl. 18, fig. 1; pl. 19, fig. 1.

Body color and pattern much as in the female but brighter and more distinct. Cephalothorax with an indistinct submarginal band of white hair in patches; sides of head with a conspicuous patch of white hairs as in the male of D. tenebrosus. Eyes surrounded with black and placed as in female except that posterior median are as large as the posterior lateral and separated from them by their diameter. Clypeus dusky with a median, vertical, light stripe; width of clypeus, about twice the diameter of an anterior median eye. Chelicera yellow with a diagonal, dark stripe down the front. Anterior half of abdomen above dark brown with a median, lanceolate, light stripe, posteriorly with a series of chevrons, dark brown on the lighter ground; venter yellowish. Legs proportionally longer and more slender than in female; yellowish, blotched irregularly with blackish; coxae immaculate. Sternum yellow with gray border; Labium yellow tinged with gray. Endites pale yellow. Palpus: the bulb resembles that of D. tenebrosus but is proportionally longer and more slender. The median apophysis (which in D. tenebrosus is sharply bent at the middle of its length and has the basal part greatly swollen) is bent at a right angle and the basal part is only slightly enlarged (pl. 19, fig. 1).

Remarks. The relation of this species to Dolomedes tenebrosus Hentz is evidenced not alone by size and general appearance but by structure of the sexual organs. Although the differences in the structure of these organs in the two species are not striking, they are constant and readily discernible and must be considered of specific value.

Habits. This species and Dolomedes tenebrosus were both collected under similar conditions on Billy's island, Okefinokee swamp, Georgia and no observations were made that would indicate striking differences in habit. They were found on herbage and the prostrate trunks of trees and not usually in such close proximity to water as in the case of Dolomedes albineus and Dolomedes triton.

Distribution. *Billy's island, Okefinokee swamp, Ga.; *Coosa river near Three Island shoal, Talladaga county, Ala.; *Chastine, La.

Dolomedes tenebrosus Hentz

Bost. Jour. Nat. Hist., 1843, 4:306, pl. 19, figs. 10-13

Type: Dolomedes tenebrosus Hentz; type specimen not known to exist

Type locality: Hentz stated the habitat to be, "Carolina, Alabama, Massachusetts?"

Female (alcohol): length 15-26.5mm; average of ten mature specimens 21.8mm; legs 4-1-2-3, 46-44-42-40mm; pl. 20; pl. 21, figs. 2-5

Cephalothorax above reddish brown; back of the posterior eyes an oval area lighter brown; in front of dorsal groove a short, narrow, light line separates a pair of indistinct, dark, wedge-shaped marks and joins the oval area; extreme margin of cephalothorax black; a broad submarginal band lighter brown, more or less broken by the dark, radial furrows, the outer ends of which usually inclose a small, white spot. Eye area and front of head black; below the lateral eyes of the posterior row, an area of light yellowish brown joins the submarginal band and extends to the sides of the clypeus. Cephalothorax clothed with fine, white, and short, brown hairs, the white predominating on the radial furrows and sides of head, the brown in patches along the upper edge of the submarginal band. *Eyes* of anterior row in a slightly recurved line; median separated by about one-half the diameter of one of them; median about twice the diameter of the lateral and nearer to them than to each other; posterior row strongly recurved, median eyes less than their diameter apart and larger than those of anterior row; lateral eyes largest, separated from median by the diameter of one of them. *Clypeus* dark brown to black, often with an indistinct, median, light line. *Chelicera* dark brown to black clothed with long, light hairs. *Abdomen* with ground color of dorsum yellowish brown with darker patches outlining a median figure on the anterior half much as in D. scriptus; posterior half with a central, dark band broken into three or four chevrons the lateral ends of which bear a small, dull white spot. Sides of abdomen reddish or yellowish brown, venter usually with two narrow, light lines converging from ends of epigastric furrow to spinnerets. *Legs* usually banded above with dark brown on a ground color yellowish or reddish brown; femora above mottled; tibiae, metatarsi and tarsi each with two dark bands; legs below lighter, coxae usually without markings. *Sternum* yellowish brown darker on the margins; in immature specimens often with a median, light stripe as in D. scriptus.

Labium and endites dark reddish brown, lighter distally. ***Epigynum*** with the median lobe convex, hemispherical, bordered behind by the lateral lobes which are broadly in contact on the middle line.

Male (alcohol): length, 7.5mm to 12.5mm; legs (1-2)-4-3, 20-20-19-16mm; pl. 18, fig. 2; pl. 21, fig. 1.

Cephalothorax above much as in the female but with colors brighter and in greater contrast; submarginal, light bands distinct; light patches on sides of head covered with short, white hairs. *Chelicera* yellowish white with a broad dark longitudinal stripe on the front. Anterior half of abdomen above dark brown to black sometimes bordered on the sides with dull yellow; median figure obscure; chevrons on posterior half of abdomen sometimes united and bordered by dull yellow; sides of abdomen gray, venter somewhat lighter. *Legs* yellowish white with broken annulations; coxae yellow. ***Sternum*** margined with dusky, center yellow. Tibia of palpus short; the external apophysis broad, concave internally, and armed at each distal corner with a sharp tooth; sometimes one or two teeth between the lateral ones. The median apophysis of the bulb sharply angled at the middle of its length, basal half strongly swollen in the middle.

Synonymy

Dolomedes tenebrosus Hentz, Bost. Jour. Nat. Hist., 1843, 4:396, pl. 19, figs. 10-13

Dolomedes tenebrosus Hentz, Reprint, Occ. Papers Bost. Nat. Hist., 2, 1875, p. 38, pl. 5, figs. 10-13

Dolomedes tenebrosus, Marx, Proc. Nat. Mus., 1890, 12:566

Dolomedes tenebrosus, Banks, Proc. Acad. Nat. Sci. Phila., 1892, 44:73

Dolomedes tenebrosus, Marx, Proc. Ent. Soc. Wash., 1892, 2:160

Dolomedes tenebrosus, Fox, Proc. Ent. Soc. Wash., 1892, 2:209

Dolomedes tenebrosus, Banks, Jour. N. Y. Ent. Soc., 1895, 3:91

Dolomedes tenebrosus, Banks, Ent. News, 1895, 6:206

Dolomedes tenebrosus, Slosson, Jour. N. Y. Ent. Soc., 1898, 6:248

Dolomedes idoneus Montgomery, Proc. Acad. Nat. Sci. Phila., 1902, 54:588-590, pl. 30, fig. 51

Dolomedes idoneus Montgomery, Proc. Acad. Nat. Sci. Phila., 1903, 55:654

Dolomedes tenebrosus, MacGillivray and Houghton, Ent. News, 1903, 14:262

Dolomedes tenebrosus, Britcher, Proc. Onon. Acad. Sci., 1903, 1:129

Dolomedes idoneus Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:319

Dolomedes tenebrosus, Ruthven, Rep't, State Board Geol. Surv. Mich., 1906, p. 100

Dolomedes tenebrosus, Banks, Ind. Dep't Geol. and Nat. Res. 31st Ann. Rep't, 1907, p. 743

Dolomedes idoneus, Bryant, Occ. Papers Bost. Soc. Nat. Hist., 7, 1908, p. 79

Dolomedes idoneus, Emerton, Trans. Conn. Acad., 1909, 14:211, pl. 7, fig. 8

Dolomedes vernalis Emerton, ibid., pp. 211-212, pl. 7, figs. 7, 7d

Dolomedes tenebrosus, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 53

Dolomedes vernalis, Banks, Proc. Acad. Nat. Sci. Phila., 1911, 63:452

Dolomedes tenebrosus, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:542

Dolomedes vernalis, Petrunkevitch, ibid., p. 543

Dolomedes vernalis, Comstock, The Spider Book, N. Y., 1912, pp. 613–614, figs. 702–703

Dolomedes tenebrosus, Comstock, ibid., pp. 608–609, figs. 694–695

Dolomedes idoneus, Barrows, Ohio, Jour. Sci., 1918, 18:313

Dolomedes idoneus, Gibson, Ent. Soc. Ont., 47th Ann. Rep't 1917, p. 170

Dolomedes idoneus, Emerton, Trans. Roy. Can. Inst., 1919, 12:327

Remarks. Hentz's description of the species is brief but the figures are recognizable and I see no reason why his name should be discarded. Montgomery (1902) applied the name D. idoneus and has been followed by other writers in several instances. Emerton (1909) has pointed out, that the female described by him in 1885 under the name D. tenebrosus was a specimen of D. scriptus (fontanus Em.) and that the male of another species, D. vittatus (called D. urinator by Emerton) was described as D. tenebrosus. The true male of D. tenebrosus was described by Emerton under the name D. vernalis.

The difference in size of the sexes in the north is striking, the females averaging over 20mm in length, the males about 7.5-8mm. Males from the south are larger. A specimen from Baton Rouge, La., 12.5mm long, has the first legs 34mm and the third legs (the shortest) 29mm long. Two specimens from Virginia measure respectively 11 and 8mm; one from Washington, D. C., 9mm. New York and Ohio specimens are about 7.5mm long with the longest legs, first and second, about 21mm.

Habits. In the north adults of both sexes have been found in May, indicating earlier maturity than in the case of D. scriptus; it is in June, however, that mature specimens are commonly found. In the south the males may be fully grown early in the spring and at Baton Rouge, La., Comstock collected one in March.

It is probable that during the mating season this species may be found in the vicinity of water; later in the season, however, I have found many immature specimens a considerable distance from water in dry woods. In August on Valcour island, Lake Champlain, where females of D. scriptus had their nurseries in almost every rock crevice near water, many immature individuals of D. tenebrosus inhabited an old tent several hundred yards from the lake. A single mature female was found under a short board on the hard ground. An immature male was found in May at Thacher Park, Albany county, halfway up a dry hillside on a log. Since immature specimens of all sizes have been found late in the fall, it is evident that neither this species or D. scriptus matures in one season; in fact immature specimens have been found in hibernation in November at Ithaca, N. Y. The species in the north is not common compared with D. scriptus but farther south, in Virginia and Maryland they occur in great abundance.

Various species of this genus have been recorded as capturing and feeding on fishes. McCook (v. 1, p. 235) mentions a case in which a fish three and one-fourth inches long was captured and drawn from the water by a spider only three-fourths of an inch in length. More recently, Thomas Barbour has recorded the capture of small Cyprinodonts by spiders identified as Dolomedes tenebrosus (Psyche, 1921, 28:131-132).

Distribution. *Ottawa, DeGrassi Point, Ont.; Truro, N. S.; Chelsea, DeGram Point, Quebec; Falmouth, Me.; Franconia, Three Mile island, Lake Winnipesaukee, N. H.; Vermont; New Haven, Simsbury, Conn.; Blandford, Mass.; Crosswicks, N. J.; West Chester, *Shawanese lake, Pa.; in New York specimens examined from *Hemlock lake; *Gloversville; *Thacher Park, Albany county; *Mountain lake; *Berkshire, Tioga county; *Ithaca; *Valcour island, Lake Champlain; *Deer island, Thousand islands; *Keene Valley, Essex county; *Axton; *Manlius, Onondaga county; *Cold Spring Harbor, L. I.; *Juanita island, Lake George; Maryland specimens from *Clearspring; *Wolfville; *Hagerstown; *Meyersville; *Cabin John; *Sycamore island; *Plummers island; Delescarlia reservoir; *Great Falls; *Cedargrove; *Glen Echo; *Forest Glen and *Receiving reservoir; *Rock Creek, *Potomac river, *Washington and *Eastern Branch, D. C.; Falls Church, *Black pond, *Langley, *Scott's Run, *Fort Monroe, Va.; *Clifton, Ky.; *Woodville Greenecastle, *Wilders, *Wyandotte, Ind.; Porcupine mountains, *Douglas lake, *Isle Royale, Mich.; *Ames, *Jefferson, Iowa; *Pokegama lake, Minn.; *Walhalla, N. D.; *Gambier, *Rockbridge, *Olive, and *Highland county, Ohio; Gangers, Ill.; Swannanoa valley, N. C.; *Memphis, *Beersheba, Tenn.; *Columbia, Mo.; *Baton Rouge, La.; *Billy's island, Okefinokee swamp, *Thompson's Mills, *Rosswell, Ga.; *Letura, Coosa river, Ala.; *Brownwood, Texas; *Archer, Fla.; *Fort Yuma, Ariz.

Dolomedes scriptus Hentz

Bost. Jour. Nat. Hist., 1845, 5:189, pl. 16, fig. 1

Type: Dolomedes scriptus Hentz; type specimen not known to exist

Type locality: Alabama

Female (alcohol): length 17.5-24mm; average of 15 mature specimens, 20.6mm; legs 4(2-1)-3, 39-35-35-33mm; pl. 22; pl. 24, fig. 2

Cephalothorax above light to dark brown; a narrow, median, light line originating between the middle eyes of the second row extends to the posterior margin of cephalothorax; in front of dorsal groove a pair of small, wedge-shaped spots clothed with short, black hairs (in a rubbed specimen, the spots are often absent); regularly curved, light lines, inclosing an oval area, extend from the median sides of the posterior lateral eyes to the wedge-shaped marks; thorax narrowly margined with black and on each side a broad, submarginal, dusky yellow band often broken into oblique spots; eye area dark. *Eyes:* anterior row in a slightly recurved line; median separated by about the diameter of one of them, a little larger than lateral; lateral eyes less than the diameter of one of them from the median; posterior row strongly recurved, larger than anterior; the median separated by the diameter of one of them, a little further from the lateral. *Clypeus* dark brown to black, often with a median vertical light line. *Chelicera* reddish brown, clothed with mixed white and brown hairs, the white predominating. *Abdomen:* Anterior half of abdomen above dark brown with a median, light stripe bifurcating posteriorly; on each side, an oblique, light line joins the median one near the middle of its length, the acute angle inclosed having its apex directed forward; at the juncture of the oblique lines with the median stripe, there is often on each side a curved, light line extending forward to meet the median line on the front margin of the abdomen; posterior half of abdomen crossed by three or four transverse, W-shaped white or yellowish white lines with the intervals between them brown or black; sides of abdomen light brown or grayish; venter uniform light brown. *Legs* and palpi with the ground color somewhat lighter than that of the thorax; above more or less distinctly annulate and bearing numerous dark brown and white hairs in patches, and conspicuous spines; beneath, lighter, yellowish or greenish gray; metatarsi and tarsi distinctly scopulate; coxae immaculate. *Sternum* dark brown with a median, often branched, light, longitudinal line. *Labium* and endites brownish yellow, lighter distally. *Epigynum* reddish brown, broader than long with the median sides of the lateral lobes evenly curved and extending forward about three-fourths the length of the epigynum; median lobe slightly excavated in front; behind, somewhat convex and attaining the posterior margin of the epigynum.

Male (alcohol): length, 13-16.25mm, average of five mature specimens, 14.5mm; legs 4-2-1-3, 40-38-37-35mm; pl. 23; pl. 24, fig. 1.

Body color and pattern in general like female; submarginal band of cephalothorax usually more distinct and often continued across the clypeus; chelicera yellowish; legs and palpi lighter, not annulate. Palpus: external apophysis of tibia near the middle of its length; broad, concave internally and armed distally with two large teeth. Median apophysis of the bulb well developed, narrow basally, broad distally and with the point turned toward the tip of the embolus.

Synonymy

Dolomedes scriptus Hentz, Bost. Jour. Nat. Hist., 1845, 5:189, pl. 16, fig. 1

Dolomedes scriptus Hentz, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, pp. 38-39, pl. 6, fig. 1

Dolomedes fontanus Emerton Trans. Conn. Acad., 1885, 6:502, pl. 49, fig. 10 (male)

Dolomedes tenebrosus, Emerton, ibid., p. 501, pl. 49, fig. 9c (female nec male)

Dolomedes scriptus, Marx, Proc. Nat. Mus., 1890, 12:566

Dolomedes tenebrosus, Stone, Proc. Acad. Nat. Sci. Phila., 1890, 42:433, pl. 15, fig. 8

Dolomedes scriptus, Banks, Ent. News, 1891, 2:86

Dolomedes scriptus, Banks, Proc. Acad. Nat. Sci. Phila., 1892, 44:73

Dolomedes scriptus, Banks, ibid., 1916, 68:82 (Banks' specimens in collection of Cornell University are typical D. scriptus)

Dolomedes scriptus, Banks, Jour. N. Y. Ent. Soc., 1894, 2:52

Dolomedes scriptus, Slosson, ibid., 1898, 6:248

Dolomedes scriptus, Banks, Proc. Acad. Nat. Sci. Phila., 1901, 52:538

Dolomedes scriptus, Banks, Proc. U. S. Nat. Mus., 1902, 25:216

Dolomedes tenebrosus, Emerton, Common Spiders, 1902, pp. 87-88, figs. 213-214 (female nec male)

Dolomedes urinator, Montgomery, Proc. Acad. Nat. Sci. Phila., 1902, 54:586-590 (female)

(Montgomery described the female of D. scriptus but figured the epigynum of D. urinator)

Dolomedes scriptus, Britcher, Proc. Onon. Acad. Sci., 1903, 1:120 (Specimens are in the collections of the American Museum)

Dolomedes fontanus, Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:316-317, pl. 20, figs. 35-37

Dolomedes fontanus, Bryant, Occ. Papers Bost. Soc. Nat. Hist., 7, 1908, p. 79

Dolomedes fontanus, Emerton, Trans. Conn. Acad., 1909, 14:210-211

Dolomedes fontanus, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 53

Dolomedes fontanus, Banks, Proc. Acad. Nat. Sci. Phila., 1911, 63:452

Dolomedes fontanus, Petrunkevitch, Amer. Mus. Nat. Hist. Bul. 29, 1911, p. 541

Dolomedes fontanus, Comstock, The Spider Book, N. Y., 1912, p. 609, figs. 696-698; p. 118, fig. 114

Dolomedes fontanus Emerton, Trans. Roy. Can. Inst., 1919, 12:327

Remarks. This species, the Dolomedes fontanus of Emerton, is clearly figured by Hentz. It is the only species of the genus with the abdomen marked with transverse, W-shaped, white lines although this pattern is approximated by D. tenebrosus. The markings of the cephalothorax are likewise distinctive, being much more prominently developed than in the related species. Hentz specimens, taken in March, were immature and on such individuals the wedge-shaped patches of dark hair on the cephalothorax are often indistinct (obsolete); even mature specimens when rubbed lose these spots. Emerton (1885) correctly figured the male palpus under the name D. fontanus; he described the female and figured the epigynum as that of D. tenebrosus but later (1909) he called attention to the error and corrected it. Montgomery (1902) described the female under the name D. urinator and from the several specimens of both species before him selected one of D. urinator to figure the epigynum. Banks (1892) records the species from Ithaca but in his revision he states that his specimens were the young of D. tenebrosus. These specimens are in the Cornell collection and are typically marked specimens of D. scriptus. Banks (1891) pointed to the right determination of the species when he wrote: "What I feel sure is D. scriptus H. has the epigynum as figured by Emerton (1885) for D. tenebrosus."

Habits. Dolomedes scriptus is the commonest species of the genus in the north. The hundred or more specimens collected were all found in the vicinity of water where they frequent old docks and boathouses or hide beneath stones and rubbish along the shores of ponds, lakes or streams. The females are most easily found and captured when burdened with their egg sacs or guarding the young in the nurseries; at such times they seldom try to escape and attack vigorously anything thrust within reach. The males reach maturity a month or so before the females, which are ready to mate about July 1st in the latitude of New York. In August the egg sacs are made and carried about in the chelicera until the young are ready to emerge; the sac is then attached to a convenient weed top or fastened to the side of a rock crevice between the strands that compose the nursery. The young moult at least once within the sac, escape through an opening at the bottom made by the mother, and shortly after moult again. For several days they may remain clustered about the deserted sac but if disturbed, they flow out along the strands of the nursery like a puff of smoke, a protective reaction to reduce mortality when attacked.

An hour later perhaps they will again be found in a compact mass which resembles a curled leaf or a dried burr. After leaving the nurseries, the young are often found a considerable distance away, hiding in the grass and leaf mold.

Distribution. This species is widely distributed in the east from Canada to Florida. Truro, Nova Scotia; Thousand islands, Ont.; * Fort Francis, La Sienne river, Can.; * Bethel, Poland, * Windham, Me.; * Hollis, Dublin, Franconia, Three Mile island, Lake Winnepesaukee, N. H.; * Hayward, * Woburn, Vt.; * South Meriden, Conn.; * Ramsey, N. J.; * Kingston, Pa.; * Columbus, Ohio; * Ames, Iowa; * Falls Church, Great Falls, * Scotts Run, Va.; * Broadwater, * Cabin John, * Beltsville, Md.; * Washington, D. C.; * Woodford county, Ky.; Roan and Black mountains, N. C.; * Glenhaven, Tenn.; Hot Springs, Ariz.; Fort Collins, Colo.; * St Louis, Mo.; Auburn, Pratt's Ferry, Alabama; * Arden, Fla. In New York State they are particularly numerous on the islands and along the shore of Lake Champlain and Lake George. Many specimens have been examined from * Valcour island, Lake Champlain; * Elizabeth island, * Juanita island, * Pearl point and * Kattskill bay, Lake George; others from *Albany; * Ithaca; * Locke; * Slingerlands; * Cazenovia; * Onondaga lake; * Pike pond; * Burden's lake, * Tackawasick pond, * Kinderhook lake and * East Greenbush, Rensselaer county; *Ashokan reservoir; *Merrill, Clinton county; * Chilson lake, Essex county; * Rider's Bridge, Columbia county.

Dolomedes vittatus Walckenaer

Hist. Nat. Ins. Apt., 1837, 1:347

Type: Dolomedes vittatus Walckenaer; type specimen not known to exist

Type locality: Ogechee river swamp, Ga., April 10th

Female (alcohol): Length 19.5mm; legs 4-(1-2)-3, 41-37-37-34mm; pl. 24, fig. 3; pl. 25

Cephalothorax above reddish brown or greenish gray densely clothed with short, red or gray hairs; extreme margin with a fringe of long, dark hairs; a broad, submarginal band of short, white hairs, very conspicuous when dry, extends from the posterior margin of the thorax along the sides, and narrowing crosses the clypeus; in front of the dorsal groove, a pair (sometimes united) of wedge-shaped patches of brown or black hairs; head within the curvature of the posterior eyes, somewhat more elevated than in other species of the genus; behind the posterior eyes, a fringe of long, yellowish hairs directed forward; reddish brown color of dorsum continued forward to include the eyes and upper third of clypeus. *Eyes:* anterior row slightly recurved; subequal in size and equidistant, scarcely the diameter of one of them apart; posterior row strongly recurved, almost twice the diameter of the anterior; the median separated by a little more than half the diameter of one of them; about their diameter from the lateral. *Chelicera* dark reddish brown, clothed with long, dull yellow hairs. *Abdomen* above dull reddish brown to black clothed densely with short, brown hairs; on the anterior half, an indistinct, median, lanceolate mark somewhat lighter; first two pairs of muscle impressions made conspicuous when dry by small patches of short, white hairs; broad bands of short, white hairs, one on each side of the abdomen are continuous with those of sides of cephalothorax; from each of these bands, behind the middle of the length of the abdomen a pair of short branches extend toward the disk; abdomen below, uniform reddish or grayish brown (yellow when dry) and densely clothed with mixed dull yellow and gray pubescence. *Legs:* femori mottled with dark gray or brown on lighter ground in some, others more or less annulate; remaining segments above uniform reddish brown or indistinctly banded; legs below uniform dull brown or dusky with faint indications of annulations. *Sternum* in old individuals dull brown, in immature specimens often with a light median line. *Labium* and endites reddish brown, lighter distally; endites scopulate distally with long, dull yellow hairs. The *epigynum* resembles that of D. urinator but is less than twice as broad as long; the lateral lobes, rather widely separated anteriorly, are half as far apart behind (pl. 24, fig. 3).

There seem to be two color phases represented by females; in one the red tones predominate (usually old and mature specimens), in the other, gray.

Male (alcohol): Length 19mm; legs 4-1-2-3, 51-49-47-43mm; pl. 24, fig. 4; pl. 26

In this species the male is almost as large as the female and the legs are considerably longer; both sexes have the same color pattern although it is often more highly developed in the male where the lateral light bands of the cephalothorax stand out in strong contrast with the darker disk. Anterior median eyes slightly larger than and closer to the anterior lateral than to each other. External apophysis of tibia of the palpus, broad, convex externally and provided with two or three teeth at the tip; a large, blunt tooth on the tibia near base of apophysis, above and below; a cluster of basally stout, apically slender spines on the ventral side of tibia below base of apophysis. Femur of fourth legs beneath with a spinose hump.

Synonymy

Dolomedes vittatus Walckenaer, Historie Naturelle des Insectes Apteres, 1837, 1:347 (Abbot, pl. 5, fig. 21)

Dolomedes lanceolatus Hentz, Jour. Bost. Soc. Nat. Hist., 1847, 5:191, pl. 17, fig. 12 (male)

Dolomedes lanceolatus Hentz, Proc. Bost. Soc. Nat. Hist., 1868, 11:103

Dolomedes lanceolatus Hentz, Reprint, Spiders of the U. S., Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 40 pl. 7, fig. 12 (male)

Dolomedes tenebrosus, Emerton, Trans. Conn. Acad., 1885, 6:501, pl. 49, figs. 9a, 9b (male)

Dolomedes vittatus, Marx, Proc. Nat. Mus., 1890, 12:566

Dolomedes lanceolatus, Marx, Proc. Nat. Mus., 1890, 12:566

Dolomedes urinator, Banks, Jour. N. Y. Ent. Soc., 1895, 3:91 (male)

Dolomedes urinator, Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:317–318 (male)

Dolomedes urinator, Emerton, Trans. Conn. Acad., 1909, 14:211 (male)

Dolomedes vittatus, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:543

Dolomedes urinator, Comstock. The Spider Book, N. Y., 1912, pp. 612–613, fig. 701 (male)

Remarks. Under the synonymy of this species, I have included besides the original description of the female by Walckenaer and the male (D. lanceolatus) by Hentz, only those references, which by their context, show that the male was under consideration. Banks (1891) in his "Notes on Some Spiders Described by Hentz," expressed the opinion that Dolomedes urinator and Dolomedes lanceolatus were female and male of the same species, and the decision has received general acceptance. But Walckenaer described and Abbot figured a female having the markings of the male described as D. lanceolatus and I have since found several specimens which agree in size, color and markings to such an extent that it is impossible to reach any other conclusion than that Dolomedes urinator is distinct and known only from the female.

Emerton (1885) described the male of Dolomedes vittatus as Dolomedes tenebrosus but later (1909) remarked: "The male spider described by me in 1885 as the male of D. tenebrosus appears to be urinator or lanceolatus Hentz. I have not found females but have one from Pennsylvania sent me by Mr Montgomery." Montgomery (1904) under his description of D. urinator included an account of a male, using one of the specimens previously figured by Mr Emerton. I have seen this specimen through the courtesy of Mr Emerton and it is a typical male of D. vittatus (lanceolatus); but Montgomery likened it to D. urinator which it little resembles.

Simon considered D. tenebrosus Hentz a synonym of Dolomedes rufus but figured (Hist. Natur. des Araignées, 2d ed., 1898, 2:302, fig. 309 *a*) apparently following Emerton, the tibial apophysis of Dolomedes vittatus.

Habits. This may be considered one of the rarer species in the north, particularly when the females are considered; at least they are not common in collections or abundant in the field. Abbot's specimen was . . . "taken, 10th April on the body of a tree in Ogechee river swamp, very rare." Hentz's remarks, which apply to the male follow: "This spider is always found near or on water, running on it with surprising agility, preying on large aquatic insects. . . . This spider can dive and stay a considerable time under water, to avoid its enemies. It was found in March in Alabama under stones near a stream of water." Emerton's mature male was taken at Beverly, Mass., July 1, 1877, on or under stones near a brook; an immature male in the Fox collection at Cornell University was taken at Glenhaven, Tenn., in June or July; other males from Massachusetts and New York were immature in September and October. Females mature as early as the first week in June, perhaps earlier; one taken at Bee Spring, Ky., June 8, 1874, is the type of the figures here given, of the adult and epigynum. The males mature earlier in the season; one taken April 18th moulted May 11th (when it became mature) and died May 24th.

Distribution. Hentz lists the species, of which he apparently had only males, from Massachuetts, North Carolina, South Carolina and Alabama. Banks had a male from Long Island; others from * Purgatory swamp, Milton, * Beverly, * Dighton, Mass.; * Hollis, N. H.; * Green lake, Onondaga county, * New Rochelle, * Rensselaer, * Nassau lake, Rensselaer county, New York; * Falls Church, * Plummer's island, * Black pond, Va.; * Cabin John, * Cedargrove, Md.; * District of Columbia; * Olney, Ill.; * Raleigh, N. C. I have recently (June, 1923) found the females to be fairly common in a tamarack swamp near Voorheesville, N. Y.

Dolomedes triton triton Walckenaer

Hist. Nat. Ins. Apt., 1837, 1:340

Type: Lycosa triton Walckenaer; type specimen not known to exist
Type locality: Georgia
Female (alcohol): length, average, 19.5mm; legs 4-1-2-3, 29-26-26-25mm; pl. 27; pl. 30, fig. 2-3

Cephalothorax above greenish gray to reddish brown, clothed with short, dark brown hairs; a broad, submarginal, light stripe in the integument clothed with short, white hairs; extreme lateral margins often black; back of posterior eyes an oval area lighter, inclosed by a narrow, yellowish white line; a narrow, light line through the dorsal groove extends to the second row of eyes. *Eyes* of anterior row in a slightly recurved line, median slightly larger than lateral and closer to them than to each other; eyes of posterior row in a strongly recurved line, equal in size or nearly so, one-third larger than anterior; median separated by a little less than the diameter of one of them, somewhat more than their diameter from the lateral. Lower half of clypeus with a dense band of short, white hairs which joins the lateral bands of the cephalothorax; width of clypeus about 4 times the diameter of an anterior median eye. *Chelicera* yellowish or reddish brown, clothed with long, dark hair. *Abdomen* above varying from greenish gray to dark brown and bordered on each side by a broad band of white hairs more or less indistinct in alcohol; on the basal half, a median, lanceolate, light stripe and two pairs of small, white dots; on the posterior half, four pairs of white dots in two widely separated lines between which are four minute, white dots, often obsolete or wanting in old or rubbed specimens. *Legs* above colored as cephalothorax, without distinct bands or stripes; below lighter; distal joints sometimes darker. *Sternum* with three black dots on each side near the coxae. *Labium* and endites yellowish or reddish brown, lighter distally. *Epigynum* median lobe is scarcely developed on the anterior half; posteriorly it separates the lateral lobes and terminates in a rounded hump (pl. 30, fig. 2).

Male (alcohol): length, 13mm; legs, 4-1-2-3; 34-32-29-28mm; pl. 28; pl. 30, figs. 1, 4

General pattern as in female but with colors often brighter and tending more to yellow, brown or reddish brown; spots of abdomen usually quite distinct and lateral light bands, bright silvery white; black spots on sternum often connected to form irregular bands. Femur of fourth legs beneath, in adult males, with a spinose hump (pl. 30, fig. 4). Palpus: the extraordinary development of the tibial apophysis immediately distinguishes this form from all other species of Dolomedes; it is greatly elongated, spoon-shaped distally and is somewhat constricted near the base (pl. 30, fig. 1). The bulb of the palpus resembles closely that of D. albineus.

The form described above must be regarded as typical and it apparently occurs only in the south. A dozen specimens in the collections of Cornell University and the State Museum exhibit clearly those color characters described by Walckenaer[1] and figured by Abbot.[1] Walckenaer's description of the species follows: "Abdomen en ovale allongé fauve, à dos blanc sur ses côtés, et au milieu seize points d'un blanc-bleuâtre clair, six de chaque côté disposés longitudinalement, et quatre plus petits placés sur deux lignes transversales au-dessus de l'anus. Corselet allongé fauve, borde d'une raie branche sur les côtés. Pattes fauves mouchetées de taches plus foncées."

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[1] Walckenaer, Ins. Apt. 1837, 1:340, *Lycosa triton*.

The description fits Abbot's figure except that he mentions sixteen bluish white points instead of fourteen as indicated in the drawing. Evidence that Walckenaer had a specimen before him is also indicated by the fact that he gave the length as nine lignes whereas the drawing is considerably larger. This is Abbot's " water spider " and the following note accompanies the drawing: " Taken June 4th. It makes no web and keeps on the water in ponds, springs and brooks, running on the water as if on the ground. It retreats under logs, boards etc., preying on the insects it meets with, principally such as fall into it, not very common."

Specimens having the wide thoracic band I have found only in collections from Georgia, chiefly from various localities in the Okefinokee swamp. Mature females were taken in June on Billy's island; other specimens were taken from Minnie lake, Billy's lake, and the surrounding cypress bays.

Dolomedes triton sexpunctatus Hentz

Plate 29, figures 1-2

This subspecies, which is the familiar form in the north, also occurs in all the South Atlantic states and differs in the arrangement and extent of the color areas and in the smaller size of the males. In this species the light integument and white-haired submarginal band[2] of the cephalothorax is reduced to a line which is not continued across the clypeus; the white spots of the abdomen are usually arranged in two rows of five or six each, the posterior ones becoming indistinct in old or rubbed specimens. The females may be as large as those of the typical form, but the males average but 9mm in length. A large male from Georgia measures 13mm. The structure of the palpi and epigyna in the two varieties affords no grounds for their separation as distinct species although there may be slight differences noted in the shape of the tibial apophyses. In young mature males from the north, there is a more or less prominent spur or blunt tooth at the base of the apophysis which is reduced in older specimens and lost in the southern form. Dolomedes sexpunctatus Hentz is this subspecies, the name having reference to the six black dots on the sternum. Hentz figures an immature male and a small female.[1]

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[1] Abbot, Georgia Spider, pl. 10, fig. 91.

[2] The submarginal light band of cephalothorax often yellow in life.

Synonymy

Lycosa triton Walckenaer Hist. Nat. Ins. Apt., 1837, 1:340

Dolomedes sexpunctatus Hentz, Jour. Bost. Soc. Nat. Hist., 1845. 5:191, pl. 16, figs. 5, 6

Dolomedes scapularis Koch, Die Arachniden, 1848, 14:119-120, pl. 486, fig. 1354

Dolomedes sexpunctatus Hentz, Scudder's Supplement, Proc. Bost. Soc. Nat. Hist., 1868, 11:103, fig. 55

Dolomedes sexpunctatus Hentz, Reprint, Spiders of U. S., Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 41, pl. 6, figs. 5, 6, pl. 18, fig. 55.

Dolomedes scapularis, Keyserling, Verh. Zool. Bot. Ges. Wien., 1876, 26:676, pl. 2, fig. 49

Dolomedes sexpunctatus, Emerton, Trans. Conn. Acad., 1885, 6:501, pl. 49, figs. 8, 8a

Dolomedes sexpunctatus, Stone, Proc. Acad. Nat. Sci. Phila., 1890, 42:433

Dolomedes sexpunctatus, McCook, American Spiders, 1889; 1:347, fig. 339 (nursery web)

Dolomedes sexpunctatus, McCook, American Spiders, 1890, 2:145, 146, figs. 177, 178; 3:24

Dolomedes sexpunctatus, Marx, Proc. U. S. Nat. Mus., 1890, 12:566

Dolomedes sexpunctatus, Davis, Ent. News, 1891, 2:77

Dolomedes sexpunctatus, Fox, Proc. Ent. Soc. Wash., 1891, 2:260

Dolomedes sexpunctatus, Marx, Proc. Ent. Soc. Wash., 1891, 2:160

Dolomedes sexpunctatus, Banks, Proc. Acad. Nat. Sci. Phila., 1892, 44:73

Dolomedes sexpunctatus, Baker, Ent. News, 1894, 5:164

Dolomedes sexpunctatus, Banks Ent. News, 1895, 6:206

Dolomedes sexpunctatus, Emerton, Trans. Conn. Acad., 1895, 9:428

Dolomedes sexpunctatus, Slosson, Jour. N. Y. Ent. Soc., 1898, 6:248

Dolomedes sexpunctatus, Banks, Proc. Acad. Nat. Sci. Phila., 1901, 52:538

Dolomedes sexpunctatus, Banks, Jour. N. Y. Ent. Soc., 1901, 9:186

Dolomedes sexpunctatus, Emerton, Common Spiders, 1902, p. 85, figs. 210-212

Dolomedes sexpunctatus, Montgomery, Proc. Acad. Nat. Sci. Phila., 1903, 55:654, pl. 29, fig. 5

Dolomedes sexpunctatus, Britcher, Proc. Onon. Acad., 1903, 1:129

Dolomedes sexpunctatus, Banks, Proc. Acad. Nat. Sci. Phila., 1904, 56:136

Dolomedes sexpunctatus, Montgomery, Proc. Acad. Nat. Sci. Phila., 1904, 56:314-315

Dolomedes sexpunctatus, Scheffer, Trans. Kan. Acad. Sci., 1905, 19:192

Dolomedes sexpunctatus, Banks, 36th Ann. Rep't Dep't Geol. Nat. Res., 1906, p. 743

Dolomedes sexpunctatus, Bryant, Occ. Papers Bost. Soc. Nat. Hist., 7, 1908, p. 80

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[1] Spiders of the U. S., 1875, p. 41, pl. 6, figs. 5, 6.

Dolomedes sexpunctatus, Emerton, Trans. Conn. Acad., 1909, 14: 210, pl. 7, figs. 6, *6a*, *6b*

Dolomedes sexpunctatus, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 53

Dolomedes triton, Petrunkevitch, Ann. Acad. Sci., 1910, 19:219-220

Dolomedes triton, Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:542

Dolomedes sexpunctatus, Banks, Proc. Acad. Nat. Sci. Phila., 1911, 53:452

Dolomedes sexpunctatus, Comstock, The Spider Book, 1912, p. 614–616, figs. 704–706

Dolomedes sexpunctatus, Emerton, Ent. News, 1914, 25:118

Dolomedes sexpunctatus, Banks, Proc. Acad. Nat. Sci. Phila., 1916, 68:82

Dolomedes sexpunctatus, Pratt, Manual of Common Invertebrates, 1916, p. 432

Dolomedes sexpunctatus, Barrows, Ohio Jour. Sci., 1918, 18:313

Dolomedes sexpunctatus, Emerton, Ent. News, 1919, 30:168

Dolomedes sexpunctatus, Emerton, Trans. Royal Can. Inst., 1919, 12:327

Dolomedes sexpunctatus, Krecker, Ohio Jour. Sci., 1919, 19:440, 459, 472

Dolomedes sexpunctatus, Kraatz, Ohio Jour. Sci., 1921, 21:173

Remarks. Comstock[1] described two forms of the male, which he characterized as follows: "Type *a*.—In this form the width of the clypeus is about equal to the space between the anterior median eyes and the posterior median eyes; the posterior median are but little if at all larger than the anterior median eyes; the anterior row of eyes is longer than in *Type b;* and the femur of the fourth pair of legs lacks the spinose hump characteristic of *Type b.*

"Type *b:* This type of male is easily recognized by the presence of a spinose hump under the femur of the fourth legs. The width of the clypeus is two or three times as great as the space between the anterior median eyes and the posterior median eyes; the posterior median eyes are much larger than the anterior median eyes; and the anterior row of eyes is but little longer than the row formed by the posterior median eyes."

I have been unable to find a mature male of D. triton with the characters of Comstock's type *a* although material from many collections, including the Cornell University series, has been carefully examined. The spinose hump on the lower side of the femur of the fourth legs reaches full development as a secondary sexual character with the moult that frees the palpal organs, although it may be indicated some time before by a few stiff hairs.

Habits. Of all our species of Dolomedes this is perhaps the most truly aquatic. It is found in swamps, on marshes and ponds or the still reaches of sluggish streams, running on the surface or diving below to hide on the under surface of leaves or stems of aquatic vegetation (pl. 31). A film of air entangled in the hairy coat serves as a reservoir and disguise, and permits submersion for one-half an hour or longer. In the north immature males and females spend the winter hibernating in rubbish along the shores of ponds or streams or in the heaped up débris of muskrat houses. In May or early June the males mature and may be found in numbers, pursuing over the water a solitary female who may not yet be ready to receive their advances; a little later, however, mating takes place and shortly the egg sac appears and is carried about until the young are ready to emerge. I have not collected the nursery web of this species but McCook[1] gives figures of two which are of the usual form.

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[1] The Spider Book, p. 614.

Dolomedes triton resembles in habits and markings the Dolomedes fimbriatus of Europe which is said to construct a raft of floating leaves used as a resting and watching place for passing insects.

Distribution. Newfoundland; * Winnipeg, Lake of the Woods, Ottawa, Aweme, Manitoba, Canada; * Hollis, Franconia, N. H.; Wellesley, Dorchester, Swampscott, Amherst, Reading, Dedham, Ipswich, Riverside, Wood's Hole, Mass.; New Haven, Conn.; * Brittons, * Long Branch, Onondaga county, * Ithaca, * McLean, * Kenwood, * Albany, * Baldwin, * Grasmere Station, S. I., * Clyde, * Sodus Bay, N. Y.; * Trenton, * Lakehurst, Point Pleasant, N. J.; Philadelphia, Pa.; * Malta, * Columbus, Sandusky, Ohio; * Greencastle, * Buffington, Hammond, Lake Tippecanoe, Ind.; Libertyville, Glencoe ravine, Ill.; Agricultural College, Miss.; Douglas lake, Mich.; St George, Kan.; * Washington, Rock creek, Potomac river, District of Columbia; * Baltimore, Hyattsville, Md.; Great Falls, Va.; * Raleigh, Swannonoa Valley, N. C.; * Minnie Lake run, * Billy's island, * Billy's lake, * Mixon's Hammock, * Honey island Prairie Okefinokee swamp, *Fargo, Ga.; *Columbia, Springfield, Mo.; * Baton Rouge, New Orleans, La.; Auburn, Gallant, Magnolia Springs, Ala.; * Beersheba, Tenn.; Lake Worth, Fla.; Austin, Texas.

Dolomedes triton triton seems to be confined to the south. I have examined specimens from Billy's island, Billy's lake and Minnie lake, Okefinokee swamp, Ga.

Several immature specimens from Olympia, Wash., in the collection of the Museum of Comparative Zoology, are indistinguishable from D. triton sexpunctatus, but it is likely that mature individuals would exhibit characters at least of subspecific value.

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[1] American Spiders, v. 1, p. 347; v. 2, p. 145, fig. 177.

Dolomedes albiclavius nov. sp.

Type: A mature female in the collection of the Museum of Comparative Zoology, Cambridge, Mass., Nathan Banks, collector

Type locality: Springfield, Mo.

Female (alcohol): length 22mm; legs 4-1-2-3; 47-40-39-38mm; pl. 32; pl. 33, fig. 4

Cephalothorax above deep reddish brown; behind the posterior eyes an oval area of lighter brown through the center of which a longitudinal, light line extends to the dorsal groove; sides of the cephalothorax each with a broad submarginal band of short, white hairs extending from the lateral margins of the clypeus to the posterior margin of the thorax and coincident with a light stripe in the integument. *Eyes* each surrounded with a narrow, black ring; spaces between with short, white, and scattered, long and stiff, brown hairs; anterior row slightly recurved; the median, separated by less than the diameter of one of them, are a little larger than the lateral and closer to them than to each other; posterior row strongly recurved, eyes subequal in size; the median slightly less than their diameter apart, one and one-fourth times their diameter from the lateral. *Clypeus* brown with indistinct patches of short, white hairs. *Chelicera* deep brown to black clothed with long, yellowish pubescence. *Abdomen* above uniform dark brown clothed densely with short, brown hairs; upper half of sides of abdomen with a broad band of dirty white hairs not very distinct in alcohol; lower half and venter brownish and covered densely with dull yellow pubescence. *Legs* above deep brown, indistinctly mottled on the femora and clothed with short, brown hairs; below lighter with mixed yellow and brown hairs; metatarsi and tarsi scopulate beneath. *Sternum* reddish brown, darker on the margins, produced to a point behind and with the sides broadly notched at the bases of the coxae. *Labium* and endites deep brown to black, lighter distally. *Epigynum:* lateral lobes widely separated behind as in D. triton, the median lobe, from the posterior margin, extends forward three-fourths the length of the epigynum (pl. 33, fig. 4).

The male is not known.

Remarks. This large and distinct species is evidently related to Dolomedes triton but differs from it in the structure of the epigynum, in its general darker color and lack of paired white spots on the dorsum of the abdomen. The legs are proportionally and actually longer in this species than in D. triton and the body more robust.

Distribution. *Springfield, Mo., *Salt Lake, Utah; *Billy's island, Okefinokee swamp, Ga.

Dolomedes striatus Giebel

Zeit. Ges. Natur., 1869, 33:252

Type: Dolomedes striatus Giebel; type specimen not known to exist

Type locality: Illinois

Female (alcohol): length 13mm; legs, 4-1-2-3, 25-22.5-21.5-21mm; pl. 33, fig. 1; pl. 34, fig. 2

Cephalothorax above reddish brown, clothed with short, brown hair; back of the eyes an oval area, lighter, extending to the dorsal groove; sometimes a median, light line from posterior median eyes to rear margin of thorax through dorsal groove; on each side of cephalothorax a dusky yellow or white line extending from anterior lateral margin of clypeus to posterior margin of thorax; lateral, light lines parallel with the dorsal groove, not following margins of the cephalothorax. *Eyes* each surrounded by a black ring; eyes of anterior row subequal in size and forming a straight line; median separated by slightly less than the diameter of one of them, a little closer to the lateral; posterior eyes in a strongly recurved line; subequal in size; the median, separated by the diameter of one of them, are almost twice the size of the anterior median; posterior lateral separated from median of same row, by twice the diameter of one of the latter. *Clypeus* dark reddish brown with a median, vertical, light mark. *Chelicera* reddish brown clothed with long, yellow hairs and indistinctly marked with a net work of gray lines. *Abdomen* above dark brown punctuated with minute, light brown spots and clothed with short, dark brown pubescence; a median, basal mark dusky yellow, short in some, in others, lanceolate; on each side, a dull yellow stripe in the integument clothed with light yellow hair is continuous with the lines of the cephalothorax; sides of abdomen with dull yellow pubescence; venter with several alternating stripes of dull yellow and brown from epigastric furrow to spinnerets. Femora of the legs above with three longitudinal stripes of gray on the reddish brown ground; femora below more or less mottled; patellae and tibiae less distinctly striped, reddish or orange-brown; metatarsi and tarsi clear reddish brown, not striped; coxae mottled with dark brown. *Sternum* dark brown to black. *Labium* dark reddish brown, endites somewhat lighter. *Epigynum:* anterior third of median lobe excavated, behind convex; lateral lobes strongly chitinized along inner edges, converging behind to a point on the middle line. Pl. 37, fig. 1.

The male has not been described.

Synonymy

Dolomedes striatus Giebel, Zeitschrift fur die Gesammten Naturwissenschaften, 1869, 33:252

Dolomedes striatus, Marx, Proc. Nat Mus., 1890, 12:566

Dolomedes striatus, Banks, U. S. Nat. Mus. Bul. 72, 1910, p. 53 (Regarded by Banks as a synonym of *D. tenebrosus* Hentz)

Dolomedes striatus, Petrunkevitch, Bul Amer. Mus. Hist., 1911, 29:542 (Here considered as a synonym of *D. tenebrosus* Hentz)

Dolomedes sexpunctatus, Emerton, Trans. Conn. Acad., 1909, 14:210 (in part) pl. 7, fig. 6

Remarks. The specimens described by Giebel from Illinois were small, only 6mm long, and doubtless immature. This species which has apparently been confused with Dolomedes triton Walckenaer, is distinct in size, proportions, color pattern and structure of the epigynum; in fact there is a strong superficial resemblance to D. fimbriatus (Clerck). In D. triton, the light, longitudinal stripes of the cephalothorax whether narrow or broad are submarginal; in D. striatus, these stripes are parallel with the dorsal groove and a considerable distance from the lateral margins of the thorax. The abdomen of D. striatus above is uniform reddish brown except for the median, basal mark; on D. triton the abdomen above bears several pairs of small, white spots arranged in lines. The femora of the legs of D. striatus are conspicuously marked above with longitudinal stripes, characters lacking in D. triton. The median lobe of the epigynum in D. striatus extends to the anterior margin and the median extensions of the lateral lobes are contiguous behind; in D. triton the median lobe is confined to the posterior half of the epigynum and the lateral lobes are not in contact behind. D. striatus is one-third smaller than D. triton. The specimen figured by Emerton (Trans. Conn. Acad., 1909, 14:210, pl. 7, fig. 6) is apparently this species.

Habits.[1] Nothing has been written concerning the habits of this species but it is likely they do not differ greatly from D. triton in view of the fact that it has been mistaken for that species. The scopulate metatarsi and tarsi indicate that it, like other members of the genus, is in the habit of running on the surface of the water. A female with egg sac was collected at Bay St George, Newfoundland, in July; other mature females from Pine island, New York, September 8th.

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[1] On September 3, 1923, a female D. striatus and recently hatched young were found in a nursey web attached to grass and weed tops in a swale near Kinderhook, N. Y. The nursery resembled that of Dolomedes triton or some of the late season webs of Pisaurina mira. The egg sac was comparatively small, about three eighths of an inch in diameter, and attached to one side of the mass of entangled weeds and grass.

Distribution. Illinois; *Stephensville Crossing, Bay St George, Newfoundland; *Pine island, *McLean, *Ringwood and *Ithaca, N. Y.; *Douglas lake, Mich.

Dolomedes fulviatronotatus nov. sp.

Type: a mature female in the collection of the Museum of Comparative Zoology, Cambridge, Mass.
Type locality: Tamarac swamp, Pistakee, Ill., August 4, 1912, Nathan Banks collector.
Female (alcohol): length, 11mm; legs 4-1-2-3, 21-20-18-17mm; pl. 19, fig. 3; pl. 34, fig. 1

Cephalothorax above yellowish brown; in front of dorsal groove a pair of small, wedge-shaped patches of black hair; a broad, median band composed of irregular, dark spots in the integument and short, brown hairs, extends from the anterior ends of the wedge-shaped marks to posterior margin of thorax; a marginal row of irregular, black spots on each side of the thorax and a small, dark patch behind each posterior lateral eye. *Eyes* each surrounded by a black ring; those of the anterior row in a straight line, subequal in size and equidistant, less than the diameter of one of them apart; eyes of posterior row subequal in size, one-third larger than anterior, in a strongly recurved line; the median separated by the diameter of one of them, one-fourth farther from the lateral. The width of the clypeus is 3 times the diameter of one of the anterior eyes. *Chelicera* orange-yellow, lightly marked with dusky on the front and bearing irregular rows of long, yellow hair. Ground color of *abdomen* above, yellowish brown; on the anterior half, a median, lanceolate, black-edged mark; on the posterior half, three lines of black which converge at the tip of the abdomen, the middle line composed of irregular spots which diminish in size posteriorly, the outer lines irregular but continuous; on each side of the point of basal, lanceolate mark, a conspicuous, rounded black spot. Sides of abdomen dusky yellow with narrow, ill-defined, longitudinal lines of brown; venter of abdomen with three brown stripes extending from epigastric furrow to spinnerets; the median distinct and separated from the others by the yellow of the ground color. *Sternum* dark brown with black spots each side near the margin and a median, light line on the posterior half. *Labium* and endites yellow, lighter distally. *Legs* yellow with irregular patches of black around bases of spines and scattered between, more numerous below than above. *Epigynum* slightly broader than long; median lobe twice as long as broad, shallowly excavated in front; lateral lobes with strongly chitinized inner margins; the median extensions of the lateral lobes behind are short and widely separated by the median lobe.

Remarks. The diagnostic characters in so far as they are revealed in the female are those of Dolomedes, although in its color pattern it differs widely from other members of the genus. The anterior piece of the lorum of the pedicle is notched behind to receive the posterior piece, the lower margin of the furrow of the chelicera is armed with four evenly spaced teeth and the area of the median eyes is wider than long.

The male is not known.

Dolomedes pinicola (Hentz)

Bost. Jour. Nat. Hist., 1850, 6:287, pl. 10, fig. 14

Type: Micrommata pinicola Hentz; type specimen not known to exist
Type locality: South Alabama
Female, immature (alcohol): length, 11.5mm; legs 4-(1-2)-3,17-(15.5-15.5)-14mm; pl. 35.

Cephalothorax light yellowish brown above thickly clothed with short, wavy, white hair; extreme margin with a narrow fringe of stiff, black hairs directed forward; cephalic part elevated more prominently than in the other members of the genus. *Eye* area dusky; anterior row recurved, median separated by one-half the diameter of one of them, one-third larger than the lateral and nearer to them than to each other; posterior row strongly recurved, eyes about equal in size; median separated by less than the diameter of one of them, a little farther from the lateral; posterior median twice the diameter of the anterior median; median ocular area broader posteriorly than long. *Clypeus* with a broad, median, dark band the width of the anterior row of eyes; height of clypeus equals about two and one-half diameters of an anterior median eye. *Chelicera* dark brown clothed with long, white hairs; lower margin of the furrow with four teeth. *Abdomen* above dull yellow, finely reticulated and marked basally with a median, lanceolate stripe very slightly darker; sides dusky yellow; venter lighter with two lines of minute, brown dots extending from epigastric furrow to spinnerets. *Legs* light yellowish brown above, about the color of the cephalothorax and clothed similiarly with white hairs; below lighter, particularly the coxae, trochanters and basal parts of the femora;

tibiae of the first and second legs beneath armed with 2-2-2-2 spines, the apical short, others long and overlapping; metatarsi with 2-2-1 spines, apical short. *Labium* and endites orange-yellow, lighter distally.

The male has not been described.

Synonymy

Micrommata pinicola Hentz, Bost. Jour. Nat. Hist., 1850, 6:287, pl. 10, fig. 14

Micrommata pinicola Hentz, Proc. Bost. Soc. Nat. Hist., 1867, 11:104

Micrommata pinicola Hentz, Occ. Papers Bost. Soc. Nat. Hist., 2, 1875, p. 60, pl. 17; fig. 14

Micrommata pinicola, Marx, Proc. U. S. Nat. Mus., 1890, 12:560 (Refers it to the genus Ocyale)

Dolomedes albineus, Banks, Proc. Acad. Nat. Sci. Phila., 1904, 56:136

Thaumasia pinicola Banks, Bul. 72, U. S. Nat. Mus., 1910, p. 54

Thaumasia pinicola Petrunkevitch, Bul. Amer. Mus. Nat. Hist., 1911, 29:547

Dolomedes pinicola, Comstock, The Spider Book, N. Y., 1912, p. 617, fig. 710

Remarks. Hentz not only figures the spider from above but shows clearly the arrangement of the eyes and the distinctive shape of the abdomen which is widest beyond the middle of its length. The venter of the abdomen in Banks's specimen as in Hentz's description, has two lines of minute, brown dots, extending from the epigastric furrow to the spinnerets. Mr Banks, of the Museum of Comparative Zoology, kindly loaned me for study the only known specimen which he collected in Florida.

Habits. In Scudder's Supplement to Hentz's *Araneides* of the United States,[1] there is a note giving the following information: "............ found March 22, wandering on the trunks of trees like Thomisus." Apparently nothing further is known of the habits of this species.

Distribution. South Alabama, *Punta Gorda, Fla.

THAUMASIA Perty

Del. Anim. Art. Brazil, 1833, p. 192, pl. 38, fig. 5

Cephalothorax only slightly longer than broad, somewhat flattened above but with a well-marked posterior declivity. *Eyes* in two rows, the anterior slightly procurved or straight; median eyes of anterior row larger than lateral and closer to them than to each other; posterior row recurved, eyes about equal in size and somewhat larger

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[1] Proc. Bost. Soc. Nat. Hist., 1867, 11:104.

than those of anterior row; posterior median about their diameter apart, a little farther from the lateral; median ocular area a little broader posteriorly than long (pl. 37, fig. 3). Width of *clypeus* varying from two to three diameters of an anterior median eye. Lower margin of furrow of chelicera with three teeth, the last somewhat remote (pl. 37, fig. 2). *Abdomen* oval; longer than broad, widest at middle of its length. *Legs* 4-(1-2)-3 or (1-2)-4-3; long, moderately slender and armed below on tibiae and metatarsi of first and second legs with 2-2-2-2 and 2-2-2-1 spines, respectively. Paired spines of metatarsi long and overlapping; apical spine short. The anterior segment of the superior lorum of the pedicle is gently rounded behind and fits the shallow excavation of the posterior segment; lateral sclerites well developed and extending the entire length of both median segments (pl. 37, fig. 4).

Type of the genus, Thaumasia senilis Perty

Thaumasia Perty, Del. Anim. Art. Brazil, 1833, p. 102, pl. 38, fig. 5
Thaumasia Simon, Hist. Nat. Araignées, 1898, 2:313
Thaumasia Pickard-Cambridge, Biol. Cent. Amer. Arach., 1902, 2:308-309

Thaumasia peregrinus nov. sp.

Type: A mature female, no. 9427, in collection of the New York State Museum

Type locality: Hot Springs, Ark., June 27, 1901

Female (alcohol): length 10mm; legs 4-(1-2)-3; 44-(43-43)-35mm; pl. 36; pl. 37, figs. 1-4

Cephalothorax light brown above bordered by a light yellow, marginal band which extends from the sides of the clypeus to posterior margin. Short, dark brown hairs clothe the dark areas and light yellow hairs the lateral bands. Curved, light lines, extending from the posterior lateral eyes to dorsal groove, inclose an oval area. *Eyes*: anterior eyes in a straight line; median, separated by a little less than the diameter of one of them, slightly larger than lateral and closer to them than to each other. Posterior eyes equal in size and about one-fourth larger than anterior median. Median ocular area almost as long as wide posteriorly. *Clypeus* dark brown with a median, vertical, light bar; its width equals the height of the median ocular area. *Chelicera* mottled with dark brown at base, light yellow distally, and clothed with mixed brown and yellow hairs; lower margin of furrow armed with three teeth, two of which are almost contiguous, the third somewhat remote. *Abdomen* above with a broad, dull brown band sharply constricted just beyond the middle of its length, and a basal, median, light mark. Anteriorly, on each side of the middle, narrow, light lines extend to a transverse cresent-shaped mark in front of constriction; dorsal band bordered by light yellow; sides dusky yellow, darker towards tip of abdomen. Venter yellow; lighter in a narrow, median stripe. *Legs* reddish brown with interrupted darker bands on femora; below, uniform brownish except femora and coxae which are lighter. *Sternum* dusky yellow with three indistinct grayish spots on each side; it is prolonged posteriorly between the hind coxae. *Labium* longer than broad, reddish brown at base, lighter distally. *Endites* yellow. *Epigynum;* the lateral lobes are somewhat convex, slightly longer than broad and meet on the middle line anteriorly; the external openings are beneath the posterior free margins (pl. 37, fig. 1).

Male unknown.

Remarks. This species undoubtedly belongs in the genus Thaumasia, as defined by Simon and Cambridge but resembles Dolomedes in general appearance. The armature of the legs and lower margin of the furrow of the chelicera and the arrangement of the eyes and suture of the superior lorum of the pedicle is characteristic of the genus and quite sufficient for identification. This species is considerably larger than most of the described members of the genus and outside the normal range, other species being confined to subtropical or tropical regions.

EXPLANATION OF PLATES

Plate 1

Thanatidius dubius (Hentz) adult female. x 4

Plate 1

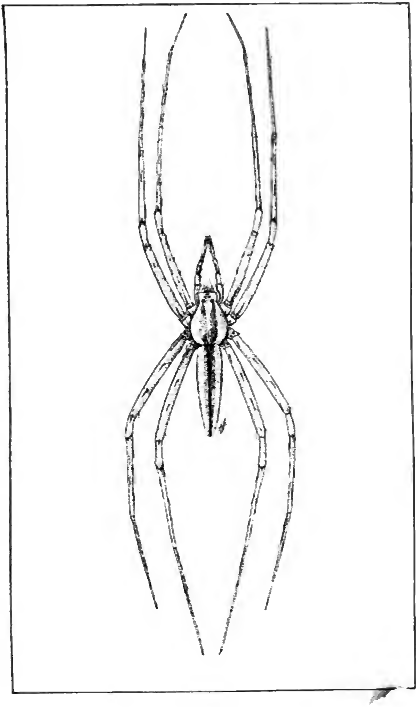

Plate 2

67

Thanatidius tenuis (Hentz)

Fig. 1 Epigynum
Fig. 2 Eyes from in front
Fig. 3 Adult female from above. x3
Fig. 4 Superior lorum of the pedicle
Fig. 5 Claw and lower margin of the furrow of the chelicera

Plate 2

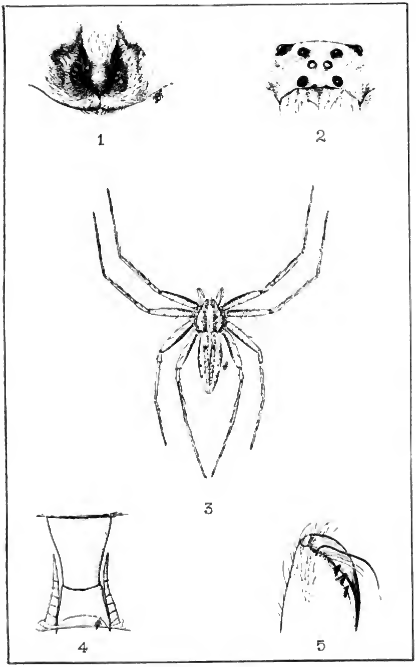

Plate 3

Pelopatis undulata (Keyserling)

Fig. 1 Female. x 2
Fig. 2 Male. x 2

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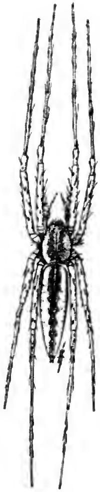
Plate 3



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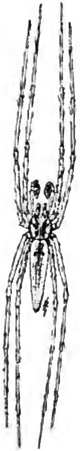

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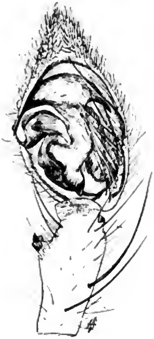
Plate 4

Pelopatis undulata (Keyserling)

Fig. 1	Palpal organ of male
Fig. 2	Eyes and chelicera
Fig. 3	Epigynum of the mature female figured in plate 3
Fig. 4	Claw and lower margin of the furrow of the chelicera
Fig. 5	Superior lorum of the pedicle

Plate 4



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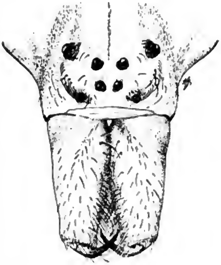

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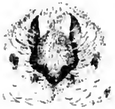

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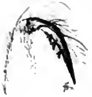

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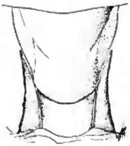

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Plate 5

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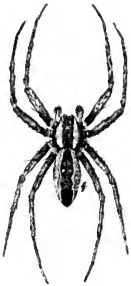
Pisaurina mira (Walckenaer)

Fig. 1 Adult female. x 2. Typical color pattern
Fig. 2 Adult male. x 2. Typical color pattern

Plate 5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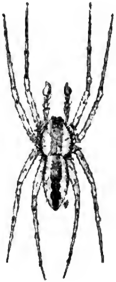
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Plate 6

Pisaurina mira (Walckenaer)

Fig. 1 Adult female. x 2. A color variety with an indication of the pattern of P. mira var. subinflata

Fig. 2 Adult female. x 2. Dark variety

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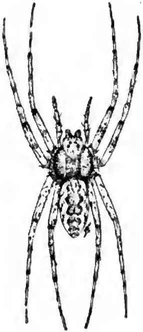

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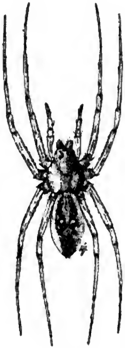

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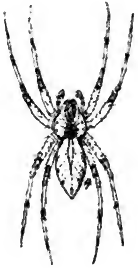
Plate 7

Fig. 1 Pisaurina mira var. subinflata female. x 2.
Fig. 2 Pisaurina brevipes Emerson female. x 3

Plate 7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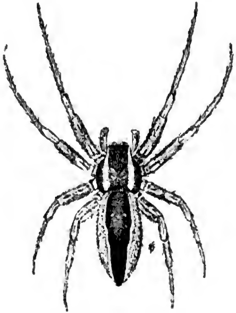
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Plate 8

Pisaurina mira (Walckenaer)

Fig. 1 Female carrying egg sac (enlarged)

Fig. 2 Female, dark variety, with the abdomen distended with eggs (natural size)

Fig. 3 Female, typical variety, removed from nursery and carrying a recently made egg sac (natural size)

Fig. 4 Female, dark variety, removed from nursery and carrying egg sac (natural size)

Plate 8

1

2

3

4

Plate 9
81

Pisaurina mira (Walckenaer)

Fig. 1 Palpal organ of male
Fig. 2 Superior lorum of the pedicle
Fig. 3 Claw and lower margin of the furrow of the chelicera.
Fig. 4 Eyes of female
Fig. 5 Epigynum of typical variety
Fig. 6 Epigynum of Pisaurina mira var. subinflata

Plate 9

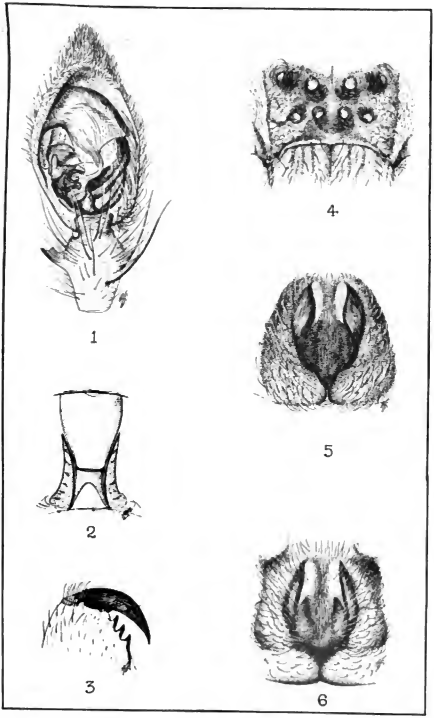
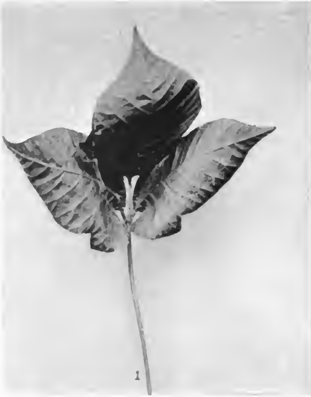


Plate 10

Fig. 1 The beginning of the nursery of Pisaurina mira (Walckenaer). Leaflets of poison ivy (Rhus) pulled together and fastened with a few strands of silk

Fig. 2 The nursery (female and egg sac inside) with a silken floor spun across the opening between the leaflets

Plate 10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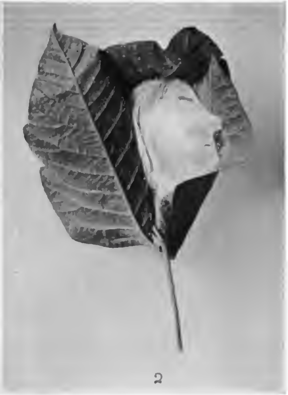
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Plate 11

A late season nursery of Pisaurina mira (Walckenaer) expanded to accommodate hatching young. Photo by J. H. Comstock

Plate 11

Plate 12

Dolomedes albineus Hentz, female. × 2

Plate 12

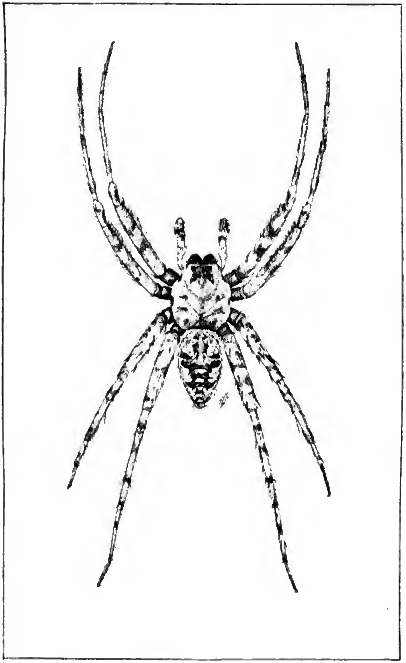

Plate 13

Dolomedes albineus Hentz, male. × 2

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Plate 13

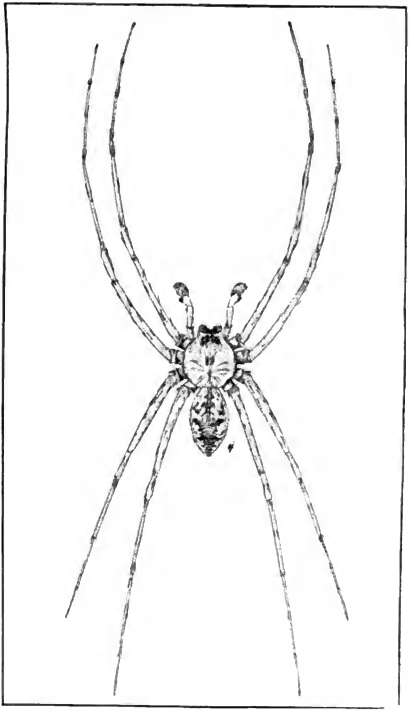
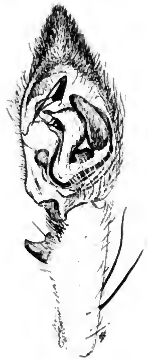


Plate 14

Dolomedes albineus Hentz

Fig. 1 Palpal organ of male
Fig. 2 Epigynum
Fig. 3 Venter of abdomen of female

Plate 14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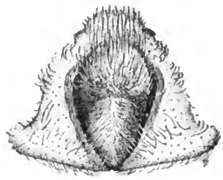
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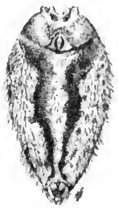
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Plate 15

Habitat of Dolomedes albineus Hentz. Upper reaches of the Suwanee river near its source in the Okefinokee swamp, Ga. The spiders cling to the bark of the cypress and tupelo trees, run freely over the surface of the water or dive beneath and cling to submerged objects to escape their enemies.

Plate 15

Plate 16

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Dolomedes urinator Hentz, female. x 2

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Plate 16

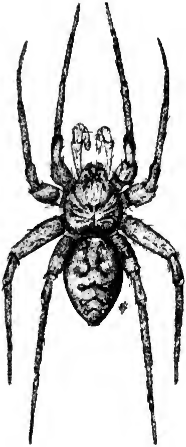

Plate 17

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Dolomedes okefinokensis nov. sp., female. x 2

Plate 17

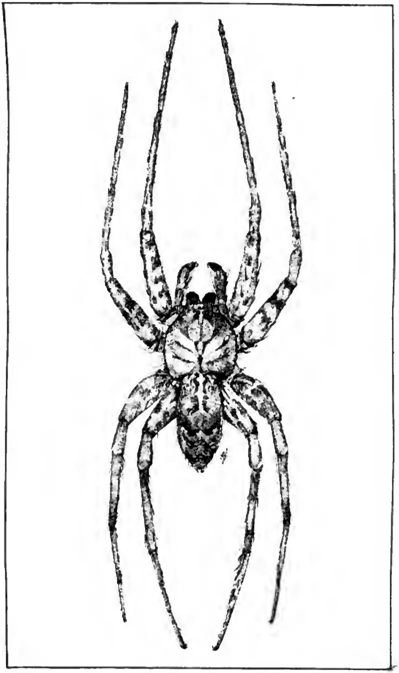
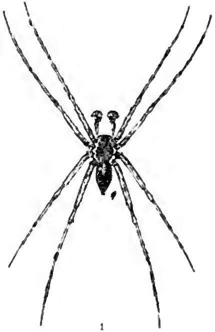


Plate 18

Fig. 1 Dolomedes okefinokensis nov. sp., male. x 2
Fig. 2 Dolomedes tenebrosus Hentz, male. x 2

Plate 18



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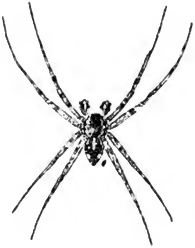

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Plate 19

Fig. 1 Palpal organ of male of Dolomedes okefinokensis nov. sp.

Fig. 2 Epigynum of Dolomedes okefinokensis nov. sp.

Fig. 3 Epigynum of Dolomedes fulviatronotatus nov. sp.

Plate 19

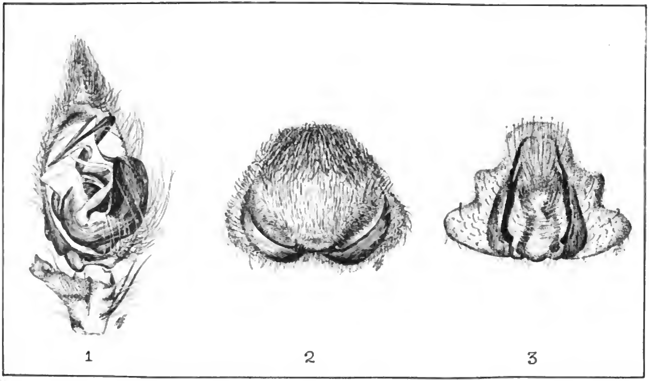


Plate 20

Dolomedes tenebrosus Hentz, female. x 2

Plate 20

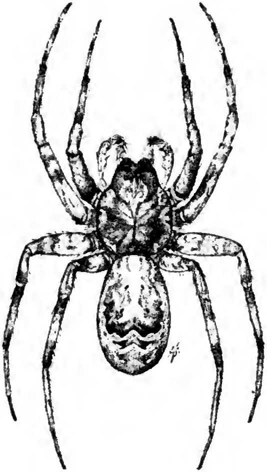
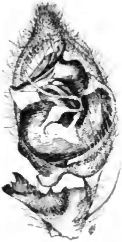


Plate 21

Dolomedes tenebrosus Hentz

Fig. 1 Palpal organ of male
Fig. 2 Epigynum
Fig. 3 Claw and lower margin of the furrow of the chelicera
Fig. 4 Eyes of female
Fig. 5 Superior lorum of the pedicle

Plate 21



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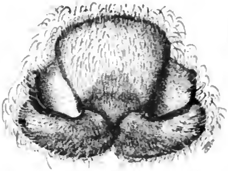

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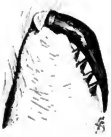

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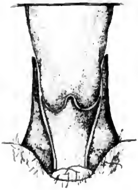

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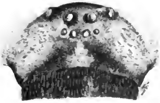

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Plate 22

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Dolomedes scriptus Hentz, female. x 2

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Plate 22

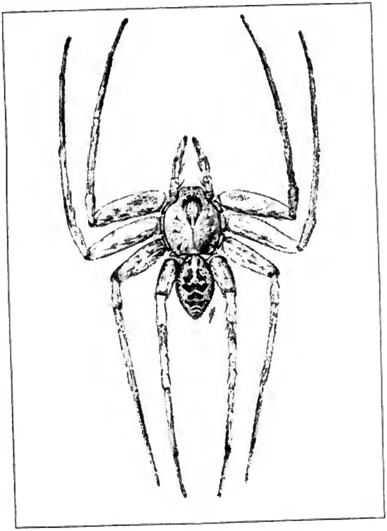

Plate 23

Dolomedes scriptus Hentz, male. x 2

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Plate 23

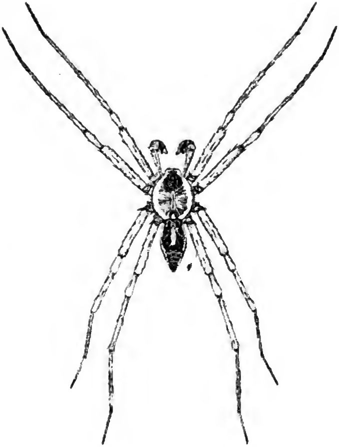

Plate 24

111

Fig. 1 Palpal organ of Dolomedes scriptus Hentz

Fig. 2 Epigynum of Dolomedes scriptus Hentz

Fig. 3 Epigynum of Dolomedes vittatus Walckenaer

Fig. 4 Palpal organ of male of Dolomedes vittatus Walckenaer

Plate 24

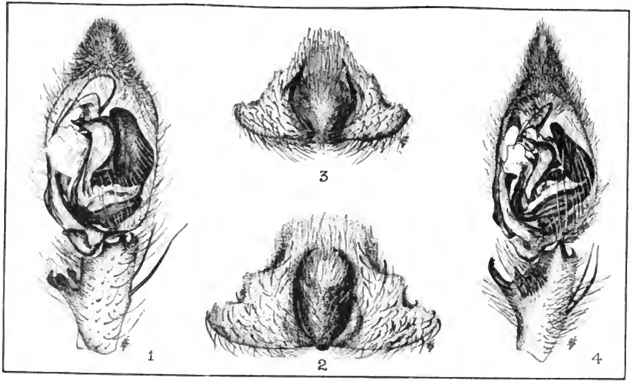

Plate 25
113

Dolomedes vittatus Walckenaer, female. x 2

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Plate 25

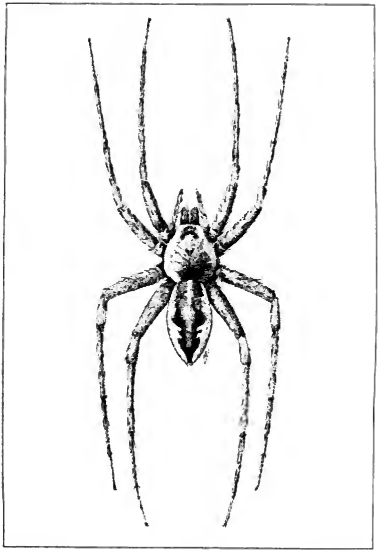

Plate 26

Dolomedes vittatus Walckenaer, male. x 2

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Plate 26

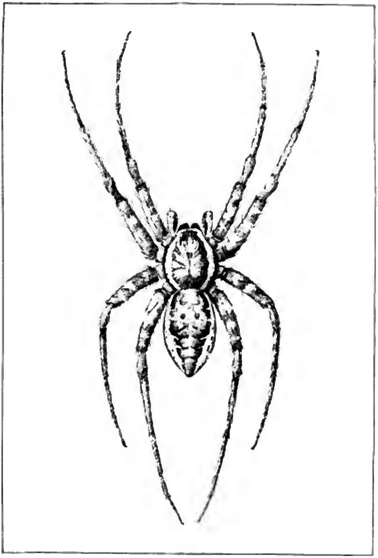

Plate 27
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Dolomedes triton triton (Walckenaer) female. x 2

Plate 27

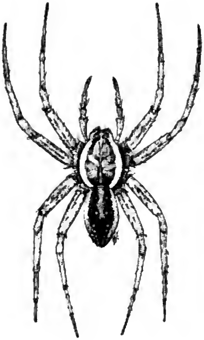

Plate 28

Dolomedes triton triton (Walckenaer) male. x 2

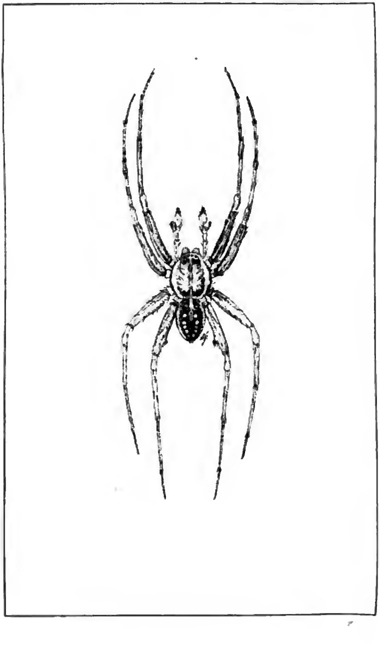

Plate 29

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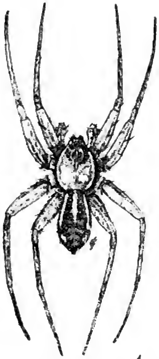
Fig. 1 Dolomedes triton sexpunctatus, female. x 2
Fig. 2 Dolomedes triton sexpunctatus, male. x 2

Plate 29



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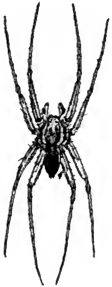

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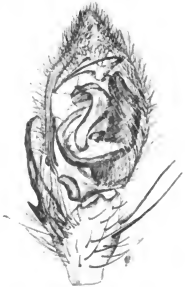
Plate 30
123

Dolomedes triton triton Walckenaer

Fig. 1 Palpal organ of male
Fig. 2 Epigynum
Fig. 3 Eyes of female
Fig. 4 Femur of fourth leg of male showing the spinose hump



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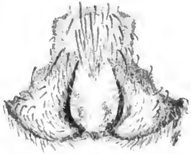

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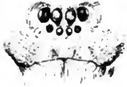

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Plate 31

Habitat of Dolomedes triton triton (Walckenaer)
A "run" between lakes in the Okefinokee swamp, Ga., filled with lily pads and bordered by cypress trees festooned with "Spanish moss."

Plate 31

Plate 32
127

Dolomedes albiclavius nov. sp., female. x 2.

Plate 32

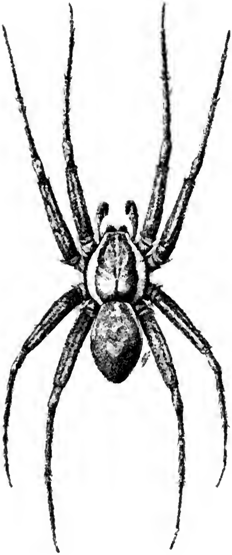

Plate 33

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Fig. 1 Epigynum of Dolomedes striatus Giebel
Fig. 2 Epigynum of Thanatidius dubius Hentz
Fig. 3 Epigynum of Dolomedes urinator Hentz
Fig. 4 Epigynum of Dolomedes albiclavius nov. sp.
Fig. 5 Epigynum of Pisaurina brevipes (Emerton)

Plate 33

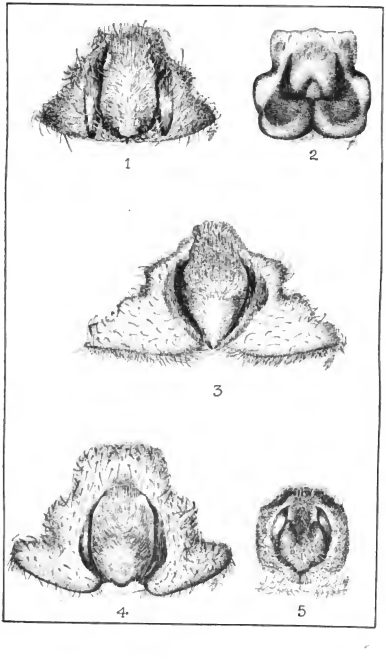
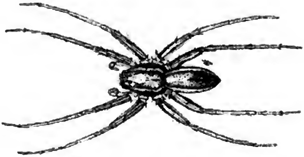


Plate 34

Fig. 1 **Dolomedes fulviatronotatus** nov. sp., female. x 2

Fig. 2 **Dolomedes striatus** Giebel female. x 2



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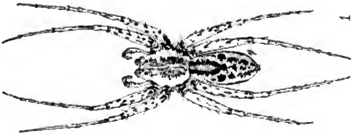

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Plate 35

Dolomedes pinicola (Hentz), female. x 2

Plate 35

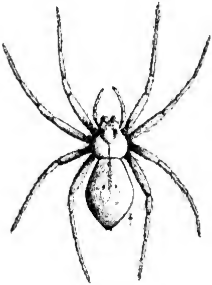

Plate 36

Thaumasia peregrinus nov. sp., female. x 2

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Plate 36

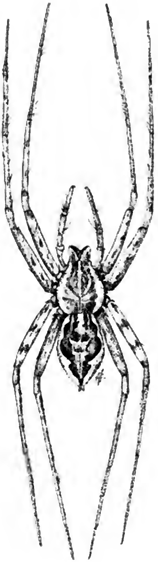

Plate 37

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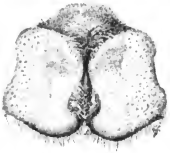
Thaumasia peregrinus nov. sp.

Fig. 1 Epigynum
Fig. 2 Claw and lower margin of the furrow of the chelicera
Fig. 3 Eyes of female
Fig. 4 Superior lorum of the pedicle

Plate 37



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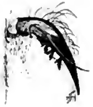

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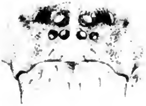

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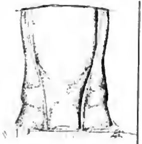

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A. H. Wright

SINGING SPIDERS

BY
SHERMAN C. BISHOP

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Twentieth Report of the Director, 1924

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THE UNIVERSITY OF THE STATE OF NEW YORK
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SINGING SPIDERS

By Sherman C. Bishop

Every one is acquainted with the songs of insects which in many cases are as characteristic of the various species as are the songs of birds. On the other hand, it is probably not generally known that some spiders are provided with delicate organs which are of such a character that we must assume them to be for the purpose of producing sound. In fact, some of the larger tarantulas are said to produce a loud hissing and one instance is reported in which the spider reared itself upon its hind legs and gave a most astonishing and terrifying demonstration. But the sounds made by the smaller true spiders have probably never been heard by human ears although it might be possible to listen to a spider chorus if our gross senses could be tuned to the proper pitch. The sounds produced by these smaller spiders are doubtless for communication between the sexes and not, as in the case of the tarantula mentioned above, for the purpose of terrifying.

Spiders are not to be regarded as having a voice of the character possessed by birds or mammals where the sound is produced by cords or membranes set in motion by the passage of air. In spiders the device may be compared more accurately with certain types of musical instruments or the simple combination of a stick and a picket fence when the first is drawn rapidly over the second. The general structure of the sound-producing (stridulating) organ is essentially the same in the various spiders in which it is developed but it is differently disposed in different species and appears in the most unexpected places. Two elements are concerned in the production of vibrations; first, a rasplike surface over which, second, a picklike spine or series of teeth is rubbed or drawn. This arrangement necessitates the placing of one of the parts on a movable base and the pick is usually developed on one of the appendages. In some cases, however, contact is between structures on the thorax and abdomen or between two appendages. The stridulating organs are developed in pairs but in the following descriptions only one of the two is considered.

In the family Theridiidae some of the males possess a file on the thorax and a pick composed of several teeth on the abdomen. In some of the spiders of the family Linyphiidae the lateral side of the chelicera of the male is furnished with a file which is scraped by a pick borne on the inner face of the femur of the palpus; in others, a pick on the basal joint of the hind legs rasps the file developed on a plate on the under side of the abdomen. In still other members of this family, the basal joint of the front legs is involved.

The structures mentioned are described more in detail under the accounts of particular species and may be understood by reference to the appended figures on which the parts are indicated. In Asagena americana (figure 1), the males have the stridulating organs conspicuously developed. The file is a roughened plate at the side of the cephalothorax near the hind margin and is scraped by a series of spine-bearing teeth borne on a ridge on the side of the front margin of the overlapping abdomen. The abdomen is capable of considerable movement up and down and the parts are thus brought in contact.

Theonoe stridula is an exceedingly minute spider, less than 1/25 of an inch in length. It belongs to the same family as Asagena and has the stridulating organ in practically the same position. The pick is developed as a short, broad tooth on the front of the abdomen and may be apposed to a striated area on the hind part of the thorax.

Lephthyphantes nebulosus (figure 2) is a representative of the family Linyphiidae in which the males have the file borne on the lateral face of the chelicera. The pick is a spinose hump on the inner side of the basal part of the femur of the palpus and is shown enlarged in figure 3. By moving the palpus up and down the pick is rubbed against the file.

The males of some of the species of Tmeticus seem to be provided not only with a file on the chelicera as in Lephthyphantes, but with another on the plate which is developed on the front part of the under side of the abdomen. Tmeticus obtusus has such an arrangement and the pick is a toothlike projection on the hind margin of the basal joint of the hind leg. By a lateral movement of the hind leg the tooth may be drawn across the roughened plate of the abdomen (figure 4). Here is provision for a duet by one individual, for the striae of the cheliceral files are much finer than the corrugations of the abdominal plates and the soprano of the mouth parts may be accompanied by the baritone of the hind legs.

Troglohyphantes is the name given to a group of small spiders, some of which are only about 1/12 of an inch in length. They are cave-inhabiting species with more of an excuse for a signaling device than the spiders which live in the light. In the male here figured, the hind face of the basal joint of the front leg is provided with a file which may be brought in contact with the pick on the front face of the second joint of the second pair of legs. This is not so complicated as it seems, as may be seen by reference to the figure (figure 5).

Organs which may serve for the reception of vibrations are not so easily discovered in spiders but in one species of Leptoneta examined there was not only a stridulating organ but an arrangement of hairs which may well serve an auditory function. On the side of the tibia of the male palpus there is a long stiff hair which has the end flattened, grooved and somewhat twisted. The grooved tip holds the end of a long slim hair which arises nearer the base of the segment. This device has recently been described as the original crystal detector.[1]

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[1] Ent. News. 36: 144, fig. 1, 1925.

EXPLANATION OF FIGURES

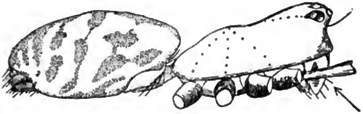
Fig. 1 Asagena americana Emerton. Male showing the file of the stridulating organ on the hind margin of the thorax and the pick, consisting of several teeth, on the front of the abdomen.

Fig. 2 Lephthyphantes nebulosus (Sundevall). In the male of this species the file is borne on the outside of the chelicera and the pick on the inner side of the femur of the palpus.

Fig. 3 Lephthyphantes nebulosus (Sundevall). Top view of the base of the femur to show the pick.

Fig. 4 Tmeticus obtusus Emerton. The file of the stridulating organ is conspicuously developed on the under side of the abdomen near the front, the pick on the hind margin of the basal joint of the hind leg. This species apparently has another file on the chelicera.

Fig. 5 Troglohyphantes sp. The male has the file developed on the hind face of the basal joint of the front leg and the pick on the second joint of the second leg.



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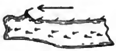

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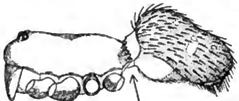

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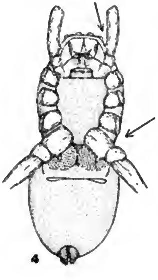

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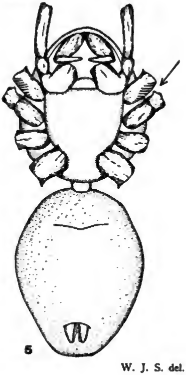

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The Life of the Red Salamander

BY SHERMAN C. BISHOP
Zoologist, State Museum, New York

THE life history of an animal is sometimes pieced together from the scattered notes of many observers. Often, however, the discovery of some essential feature is the reward of long hours in the field over a period of many years. The red salamander (*Pseudotriton ruber ruber* Sonnini) is widely distributed and locally common in the east, and zoölogists have long been familiar with the adults and larger larvæ. Nothing, however, has been written concerning the eggs and early developmental stages, and conjectures on the breeding habits have been based on knowledge of related forms.

The brilliant coloring of the newly transformed salamander marks it as one of our most beautiful species. The ground color is a clear coral-red with numerous small, rounded black spots scattered irregularly over the back, head and tail. The belly and sides are lighter and comparatively free from darker markings. In some, the skin of the underparts is so transparent that the pulsations of the heart may be observed, and the position of the liver is indicated by an elongate brownish patch. But with all its brilliancy, this salamander never forces itself upon the attention, and one who finds it must search the clear streams and springs, or turn the logs and stones in cool ravines and swamps. It may be found at all seasons of the year, but in winter it is less active and hides beneath stones and rubbish below the surface of the water. If it wanders abroad, the venture is made during the warmer months, and at night, when there is less possibility of the skin becoming dry; for this species belongs to a group whose members are without lungs. The necessary oxygen is obtained through the thin, moist skin of the body and the membrane of the throat. Hence drying means suffocation.

The eggs of many of our common salamanders are deposited in the spring or summer, but those of the red are laid in the fall (in the north at least). The young hatch in early winter. The eggs of a single female may number seventy or more. They are attached to the under surface of stones buried deep in the bed of a spring or stream, where they may be bathed in the coolest waters. The individual eggs, enclosed in gelatinous envelopes, are suspended on slender stalks, which flatten out at the point of contact with the stone to form an attachment disk. The eggs are clustered in little patches of a dozen or more, and the entire complement may cover an area several inches across.

As the young embryos develop, they gradually take on some semblance of the adult form. The more evident changes are those which involve the molding of tissue to form the head, trunk, and tail. Then the development of the gills and fore legs may be observed, and the first blush of color other than that imparted by the yolk. The gills and legs appear first as simple budlike projections; but development is fairly rapid, and the buds elongate to form, in one instance, the delicately fringed gills, and in the other, the legs with their slender toes. The hind legs develop more slowly than the fore. In

Photograph by S. C. Bishop

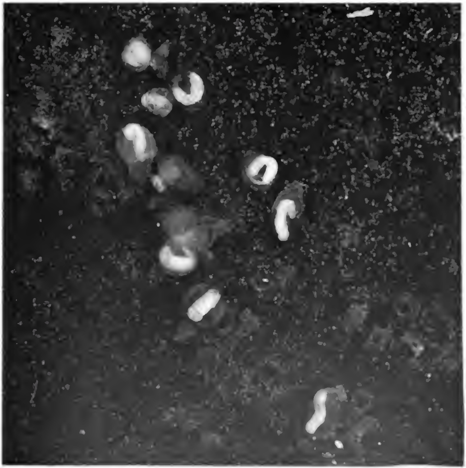
The home of the red salamander.—The red salamander frequents the springs and brooks of our northeastern states. At the base of the Helderberg escarpment in Albany County, New York, many such springs bubble forth and furnish hiding and breeding places for both red and purple salamanders

this respect the salamanders differ from our common frogs and toads.

At the time of hatching, the young salamander is scarcely half an inch long. It is endowed with stubby legs and small gills, and a belly full of yolk to carry it through the first few months of its existence. The mouth is rudimentary and incapable of functioning, the eyes are indicated by pigmented spots, and the tail is provided with a broad keel. At this stage the tail is the most important appendage, for it serves in the wriggling process which enables the larva to make its way under the stones and rubbish of the spring bottom. Here, through the cold months, it may rest almost inactive, developing its eyes and legs and mouth at the expense of the yolk, and acquiring the color and other characteristics of its kind. The yolk is lighter than the other body tissues and its buoyancy often as not turns the larva upside down.

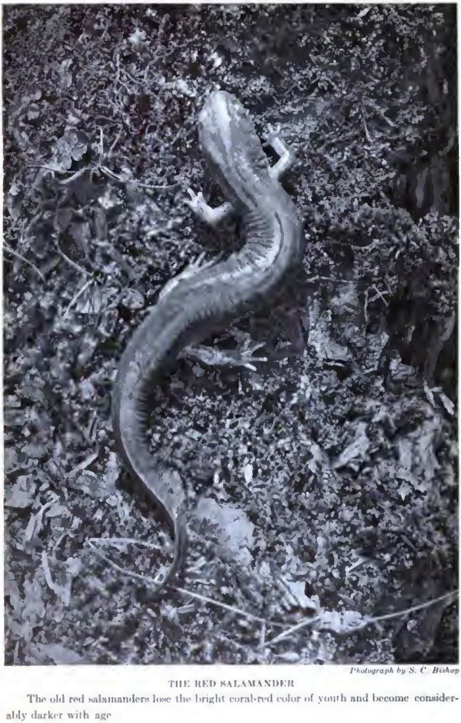
In the early spring following the winter period of relative inactivity, the young salamanders acquire a new interest in life. The yolk which sustained them has been absorbed, and they are forced to undertake foraging expeditions of their own. At this time the food consists largely of water fleas (Entomostraca) and the smaller worms and larvæ of insects, which are captured by quick, sidewise movements of the head. The feeding grounds are likely to be thick beds of cress, Chara, or other water weeds. To salamanders only an inch in length they are veritible jungles. Here the nymphs of dragon flies and beetle larvæ lie in wait and accept young salamanders as delicate additions to their diet. Newly hatched larvæ scarcely resemble the adults in color, for at this period the body has scattered fleckings of brown and black over a dull white ground color. This is a transient stage, however, and as the larvæ grow, the color becomes brighter and the spots more prominent. The ground color gradually changes from dull white to brown.

To determine the length of the larval period, it is necessary to measure a considerable number of specimens taken at approximately the same time of the year. When selected according to size, they will form groups which will in most cases, indicate the annual



Photograph by E. J. Stein

The eggs of the red salamander.—The female red salamander attaches her eggs to the under surface of stones in springs. The eggs shown above are in an advanced stage of development. Photographed under water. Slightly enlarged



Photograph by S. C. Bishop

THE RED SALAMANDER

The old red salamanders lose the bright coral-red color of youth and become considerably darker with age increments of growth. In the case of the red salamander, the larvæ which hatch in November reach a length of about one inch by April or May. Other salamanders collected at this time of the year will measure about two inches in length and represent the growth of eighteen months. The largest larvæ will have a length of four inches or more and be about thirty months old.

The most distinctive features of the larvæ are, of course, the gills. The broadly keeled tail is also a character which, in the red salamander, reaches its best development in the larvæ. As the time for transformation approaches, the larvæ gradually lose their juvenile characters and take on those of the adult. The brownish ground color gradually becomes red, the gills shrink to mere stubs, then disappear, and the tail becomes more rounded as the keels are absorbed.

These striking external changes are accompanied by others as important to the animal but much less conspicuous. The teeth, the lips, and the tongue, are involved in the changes which transform a strictly aquatic larva to the adult capable of living on land or in the water. How long the bright coral-red of the newly transformed individual is retained is a question not yet answered, but it is certain that the animal is fully adult in this stage, for specimens have been found with mature eggs.

Those who are acquainted only with the brightly colored form would scarcely recognize the individuals which have taken on the more somber colors of age. The rounded black spots spread and fuse and richer tones of purple and brown replace the coral red. Small flecks of pigment spot the lower sides and venter and the lower lip may bear a narrow band of black.

The adult salamanders are not usually social in their habits, but occasionally several will share the same small spring, and two may sometimes occupy a hollowed-out retreat beneath some log or stone. Worms, insects, and other salamanders are the chief items in the diet of the adult. They feed readily in captivity and thrive on earth worms and bits of fresh meat.

The full-grown salamander may measure six inches in length, but many are smaller. In fact some adult specimens are considerably shorter than the largest larvæ.

The enemies of this salamander are many and its life is constantly threatened from egg to old age. The eggs are sometimes eaten by other salamanders and are destroyed by fungi and molds. The young larvæ are the prey of older members of their kind and of aquatic insects. The adults may serve to eke out the meal of an owl.

This, in brief, is the history of one of our common salamanders near the northern limits of its range, one whose life story was previously not known. Further study of the salamander in regions farther south and the discovery of additional egg masses will doubtless show that the period of egg-laying extends over several months, and that the time of laying is more or less controlled by the temperature of the water.[1]

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[1] Mr. M. K. Brady, of Washington, D. C., has informed the writer that females dissected in December had mature eggs in the ovaries and that he found a batch of eggs in the field on February 10, 1915.

A. H. Wright

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SCIENCE AND SCIENTIFIC NAMES

DR. E. P. FELT AND DR. S. C. BISHOP
New York State Museum

There are now some 160,000 names of zoological genera, of which possibly 20,000 are synonyms or homonyms, and to this list there are being added each year 1,000 to 2,000 names of new genera, the average probably being about 1,500. Current zoological practice prohibits the duplication of generic names throughout the entire series and as a consequence various scientists have adopted prefixes, suffixes and other devices in a more or less successful attempt to obviate the creation of homonyms. A brief survey reveals an extremely interesting condition. Lists to the end of 1923 show nearly 3,500 zoological genera bearing the prefix Eu, over 2,000 each with the prefixes Para and Pseud, over 600 with the prefix Hemi, over 500 each with the prefixes Steno and Syn, over 400 with the prefix Acanth, and Acro, Isch and Pleur each with some 200 to 300 genera. Turning to the Insecta, we find in the Coccidae 99 genera with the root aspis and in the Itonididae or Cecidomyidae 100 genera with Diplosis compounds. A list of mammalian genera shows 348 with the root Mys and 268 with the combination Nycteris. There are surely plenty of mice in the field and possibly a superabundance of bats in the belfry. It should be noted in passing that these names, prefixes and roots have given very little aid in finding the taxonomic position of the genera, although with the exception of Eu they have four to eight letters each.

Naturally it becomes more difficult to find satisfactory combinations as the number of generic terms increases and this is suggested by some of the extremely long names, such as Asmithwoodwardia, Austroternoplatys, Brachygnathosuchus, Edvardotrouessartia, Hetaeroceocephalus, Proanthropomorphus and Pseudotarsonemoides, to cite only a few cases. In addition, there are also nonsense names.

It is granted that generic names should express something characteristic of the genus. The wholesale use of prefixes and suffixes, such as those indicated above, and the increasing tendency toward extremely long names, 18 to 21 letter combinations, is very suggestive as to future conditions. It seems probable that some of these combinations have been used more for the purpose of avoiding homonyms than to express a characteristic of the organism. We have simply been adding syllables or groups of letters with little regard for consequences, although there have been a number of attempts to introduce more or less desirable changes. One of the earliest was that of Prof. Harting[1] in 1871, a system of class suffixes combined with ordinal prefixes. The use of letter formulae for kingdom, phylum, class, order and genus and numerals for species was proposed by Tornier[2] in 1898 for both plants and animals. The use of prefixes and suffixes for the ready placing of generic names of animals and plants was proposed by Herrera[3] in 1899, and a series of initial letters for classes and ordinal prefixes by Rhumbler[4] in 1910.

The next contribution appears to be by Jonathan Dwight, Jr.,[5] in which he makes a plea for a more logical nomenclature. This was followed by Prof. James G. Needham,[6] in which he proposes the use of older generic names in approximately their original significance and the designation of species by numerals for the use of general naturalists in particular. Those interested in nomenclature and the psychology of naturalists should read the various articles on this general subject which appeared shortly thereafter.[7] Dr. Heikertinger outlined another plan[8] in 1916, elaborating certain aspects[9] in a later paper.

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[1] *Archiv f. Naturgesch.*, 4: 26–41, 1871.

[2] *Zoologischer Anzeiger*, 21: 575–580, 1898.

[3] *Science*, 10: 120–121, 1899.

[4] *Zoologischer Anzeiger*, 36: 453–471, 1910.

[5] *Science*, 30: 526–527, 1909.

[6] *Science*, 32: 295–300, 1910.

The radical proposals to indicate taxonomic relationships and other data by prefixes, suffixes and other modifications of generic names appear to have failed on account of inherent weaknesses. It is probable that zoologists as a whole are opposed to modifications of generic names, even were this permissible under present rules, and especially if the change makes it very difficult, if not impossible, to connect the original name with the new term. The unsystematic use of prefixes, either initial letters or syllables of classes or orders, adds considerably to the burden of nomenclature without any very material advantage. Consequently, earlier proposals have not met with general approval and in the meantime we are progressing rapidly and creating numerous unwieldy names characteristic of the genus to only a slight extent and significant largely because of their place in our taxonomic system. Numerals, especially decimals, afford a ready means of grouping in a fixed or well-established classification. They do not lend themselves readily to the numerous transpositions in zoology. It is physically impossible for a naturalist to keep even a reasonable proportion of the 140,000 more or less current generic names in mind and reasonably well placed in the system.

In view of the above, it is suggested that the use of prefixes based primarily upon initial letters for the principal groups affords a way out of a taxonomic tangle, since these could be used without affecting in any material way the thousands of generic concepts and yet make it extremely easy to arrange these names in approximately their systematic position by the simple process of alphabeting. Each name would automatically, through the prefix, place itself without the labor of referring to a number of standard lists.

---

[7] Cockerell, T. D. A., *Science*, 32: 428–429, 1910; Needham, J. G., *Science*, 32: 795–796, 1910; Ward, H. B., *Science*, 33: 25–29, 1911. Jordan, D. S., *Science*, 33: 370–373, 1911; Needham, J. G., *Science*, 33: 813–816, 1911; Girault, A. A., *Science*, 33: 373–374, 1911.

[8] *Zoologischer Anzeiger*, 47: 198–208, 1916.

[9] *Zoologischer Anzeiger*, 50: 41–54, 299–302, 1918–1919.

Code Prefixes for Zoological Names

These indicate a major group, phylum or class, order and family.

The first letter indicates the major group, phylum or class, the second the order and the third and fourth the families.

The first two are usually the initial letters of the major groups, the third and fourth letters are arbitrarily assigned and indicate the family position in some recognized arrangement, they being distributed somewhat through the alphabet in order to permit ready interpolations, should these latter prove desirable. Only pronounceable combinations have been used.

Prefixes are written as a part of the generic name except that the initial letter of the genus is also capitalized.

The prefixes automatically place each genus in its systematic position and in alphabeting bring into one series all genera of a family.

The prefixes add nothing to the definition of the genera other than that implied by their taxonomic position. They are simply a visible sign of generic concepts hitherto assumed except in systematic treatises and lists.

Prefixes do not alter in the slightest degree the nomenclatural status of the genus so far as date of erection, description, type and author are concerned.

They create no impassable break between present nomenclature and that suggested, since the capitalization of the original genus makes it easy to recognize the unmodified name for those who prefer the present system.

Prefixes may function not only as a classifying guide but may also be used to differentiate between many desirable generic names now unavailable because they have been used in some other class of the animal kingdom. The essential in zoological nomenclature is to prevent duplication and therefore undesirable confusion in genera, and it is held that the use of prefixes as valid, differentiating criteria in zoological genera would liberate thousands of useful descriptive terms which could be duplicated in the various classes, at least, without the slightest danger of confusion and without invalidating in any material way earlier work, provided these compounds have no retroactive effect.

Transfer from one family to another or to another order or class would be made under current nomenclatural rules as heretofore, except that the prefix would be changed to accord with the new position. In other words, the prefixes would be permanent only so long as the genus remained in a designated group.

Generic names would be proposed as heretofore and convey some idea of the genus, the prefixes being determined by their taxonomic position.

The assignments of letters or groups of letters to the various zoological groups should not be construed as attempting to establish any special classification. It is necessary to adopt some guide if a comprehensive system is proposed. There is nothing in these prefixes which would necessitate the arrangement of phyla, classes or families in any definite order, yet if they are used as a basis for alphabeting, especially in large general works, the genera will inevitably fall in related groups.

The combinations are unfamiliar and on this account appear difficult. Workers in various groups will quickly learn their significance and soon use them with facility.

The early adoption of a system of class prefixes would have made possible immense series of characteristic generic names of reasonable length and our present literature would not be burdened with unreasonably long, sometimes nonsensical and frequently far from characteristic generic designations.

The adoption of a system such as is proposed would greatly simplify the selection of generic terms in the future and should result in a much more logical nomenclature.

The application of this system is suggested by the following:

TENTATIVE SKELETON CONSPECTUS OF CODE PREFIXES FOR ZOOLOGICAL NAMES

Phyla: O, Protozoa; S, Porifera or Spongiae; C, Coelenterata; E, Echinodermata; V, Vermes; F, Brachiopoda; N, Bryozoa; D, Mollusca.

Classes: K, Crustacea; U, Arachnida; I, Insecta; G, Prochordata; P, Pisces; R, Reptilia; B, Batrachia; A, Aves; M, Mammalia.

- Ob: class, Heliozoa; phylum, Protozoa.
  - Obac: order, Aphrothoraca; phylum, Protozoa; class, Heliozoa.
- Sa: class, Calcarea; phylum, Porifera.
  - Sade: order, Homocoela; class, Calcerea; phylum, Porifera.
- Ca: class, Hydromedusae; phylum, Coelenterata.
  - Cade: order, Anthomedusae; class, Hydromedusae.
- Ic: order, Coleoptera; class, Insecta.
  - Icba: family, Cicindelidae; order, Coleoptera.
    - Genera with prefixes: IcbaAmblycheila, IcbaOmus, IcbaTetracha.
  - Icbo: family, Haliplidae; order, Coleoptera.
    - Genera with prefixes: IcboBrychius, IcboHaliplus, IcboPeltodytes.
  - Icro: family, Coccinellidae; order, Coleoptera.
    - Genera with prefixes: IcroHyperaspis, IcroHelesius, IcroHyperaspidius.
- Il: order, Lepidoptera; class, Insecta.
  - Ilaf: family, Hepialidae; order, Lepidoptera.
    - Genera with prefixes: IlafStenophis, IlafHepialus.
  - Ilke: family, Cossidae; order, Lepidoptera.
    - Genera with prefixes: IlkeGivira, IlkeAcossus, IlkePrionoxystus.

The alphabeting possibilities of prefixes are illustrated by the following list of Coleopterous genera with tentative prefixes:

IcabMaronetus
IcabNomaretus
IcabPemphus
IcabScaphinotus
IcaeAgyrtes
IcaeLyrosoma
IcaeNecrophorus
IcaeSilpha
IcafNeomedon
IcafOligopterus
IcafPaederus
IcafStenus
IcakAeolus
IcakAgrypnus
IcakLudius
IcakMeristhus
IcarCathartus
IcarOryzaephilus
IcarPediacus
IcarSilvanus
IcleAgaeocera
IcleDystaxia
IclePtosima
IcleTyndaris
IctuAulacoscelis
IctuDonacia
IctuGalerucella
IctuHaemonia

The new code prefix has been applied tentatively to the Coleoptera, Lepidoptera and Diptera and by the use of simple compounds such as those indicated above the family position of every genus has been indicated. The four letter combination makes it possible in the lower, less known phyla or large groups to at least place the genera in their orders and in some cases at least in the families. Utility has been a major consideration in assigning the prefixes, even though it involves some inconsistency. Nomenclature should possess a certain adaptability to the requirements of various groups. It is proposed to use all genera with appropriate prefixes, as written above, in literature just as we are using genera to-day. It should be remembered that all these letter assignments are purely tentative. A better method may be devised. Should the system receive favorable consideration from many naturalists, the authors would gladly work out, in cooperation with authorities in the various groups, a comprehensive system which can hardly fail to better existing conditions materially. Constructive criticism is welcomed and that of another nature may be of value. We are concerned mostly in bettering nomenclatural conditions. A modification such as suggested above will not better matters greatly in the next few years. The full benefits will hardly be apparent for some time. The system adds to the length of generic terms and to this extent is objectionable. It may be possible in the future to eliminate some of the nearly 2,000 prefixes each of Para and Pseud, in favor of more definitive prefixes and thus bring many generic names within reasonable limits, and that without changing the zoological status of the genus or materially affecting the significance of the original term. A system of alphabeted prefixes agreeing with the main outlines of recognized classifications in phyla and classes would do much to stabilize nomenclature without offering serious obstacles to advisable changes.

New York State Museum Handbook 3

NEW YORK STATE MUSEUM

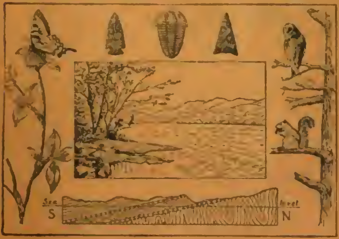
Charles C. Adams, *Director*

THE AMPHIBIANS AND REPTILES OF ALLEGANY STATE PARK

By Sherman C. Bishop, Ph.D.

Zoologist, New York State Museum

(With the collaboration of W. P. Alexander on the sections dealing with Reptiles and Field Trips)



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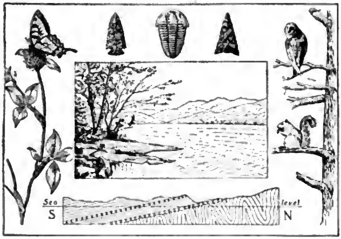

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NEW YORK STATE MUSEUM

THE AMPHIBIANS AND REPTILES OF ALLEGANY STATE PARK

By Sherman C. Bishop, Ph.D.

Zoologist, New York State Museum

(With the collaboration of W. P. Alexander on the sections dealing with reptiles and field trips)

INTRODUCTION

The Allegany State Park in Cattaraugus county, New York, lies within the loop of the Allegheny river and its tributary, Tunungwant creek. The actual boundary of the park is not the river, for bordering the stream about one-half of a mile on either side is the Allegany Indian Reservation. The south boundary of the park is the New York-Pennsylvania state line.

Nowhere in the East are to be found more favorable situations for the study of certain amphibians and reptiles than in this region. The giant Hellbender, largest salamander in the western hemisphere, is found in New York State only in the Allegheny river and a few of its larger tributaries, except where introduced; the clear, shallow waters of certain streams offer unusual opportunities for field studies of our second largest salamander, the Mudpuppy; the Purple Salamander, heretofore regarded as one of the rarer species, is to be found in great abundance in several localities. Of the more common and widely distributed species, several are locally so numerous that they offer themselves as subjects for intensive study of life histories and habits. In this category may be placed the

Redbacked, Slimy and Dusky Salamanders, the common Newt and the Wood Frog. The Timber Rattlesnake is found in numbers in several restricted areas in the park and on the adjoining reservation. Confined, as they are, to the out-of-the-way places where they are not likely to be encountered by the camper and tourist, they may be expected to persist for years as one of the most striking and interesting animals of the region. Of the harmless snakes the following, named in order of abundance, are most easily available for study: Garter, Water, Redbellied, Milk and Ring-neck. In the park proper, the Wood Turtle is the most abundant chelonian.

The physical features of the park, which are the subject of a separate detailed report (Lobeck, '27), are not here considered except as they may influence the distribution of the animals under consideration. The surface or cultural features—woods, meadows, streams, fields and backwaters—are treated more fully in terms of animal habitats with particular reference to the amphibians and reptiles.

The materials and notes on which this report is based were brought together in August 1926, and during the summer months of the five preceding years. Throughout this period, 1921–25, W. P. Alexander of the Buffalo Society of Natural Sciences collected specimens and records which have been the main source of information concerning several species. For the use of this material I am very grateful.

I am further indebted to many individuals: To Dr Charles C. Adams, Director of the New York State Museum, for the opportunity to visit the park; to W. J. Schoonmaker of the State Museum for help in collecting specimens: to the scientists who have studied in the park.

Dr H. D. House, State Botanist, Dr Rudolph Ruedemann, State Paleontologist and Dr A. K. Lobeck of the University of Wisconsin, Assistant Geologist of the State Museum, and to the many campers and visitors whose interest and helpfulness were expressed in many ways. For the use of valuable photographs I would thank Dr A. H. Wright of Cornell University, Dr C. E. Cummings of the Buffalo Society of Natural Sciences and Professor Alvin G. Whitney of the Roosevelt Wild Life Station, New York State College of Forestry at Syracuse. I would also express my appreciation of the help given by the Park Commissioners, the executive secretary, D. H. Ames and Commissioner Chauncey J. Hamlin, president of the Buffalo Society of Natural Sciences, who not only provided for the cooperation of his society but generously furnished an automobile for use in the work.

The drawings for this report have been made by W. J. Schoonmaker and E. J. Stein of the State Museum staff. Except where otherwise noted, the photographs were made by the writer.

GENERAL ACCOUNT OF THE HABITS OF AMPHIBIANS AND REPTILES

Amphibians and reptiles are cold-blooded vertebrate animals. Strictly speaking, the temperature of their blood varies with that of their surroundings, and in this characteristic they resemble the fishes and differ from the birds and mammals whose blood temperature is relatively constant. The amphibians are distinguished from the reptiles by a considerable number of characters of which the following are sufficient for the separation of the species found in the park:

Amphibia Figure 1	*Reptilia* Figure 2
Skin without scales or horny plates	Skin with scales or with both scales and horny plates
Fingers and toes without claws	Fingers and toes with claws
Gills present at least during some stage of development	Gills never present

The amphibians are represented in the park by the toads, frogs and salamanders; the reptiles by snakes and turtles. Salamanders are provided with tails, adult frogs and toads are tailless. The turtles have bony shells covered by horny plates and the fingers and toes are clawed. Snakes are covered with horny scales and are without limbs. The scales of snakes are arranged in definite rows, which are fairly constant for a given species, and may be smooth or keeled, that is, provided with a median longitudinal ridge or keel. The scales on the ventral surface or belly of the snake form a single series of broad overlapping plates called ventrals.

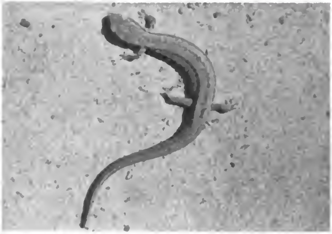


Figure 1 Example of an amphibian. Two-lined Salamander, *Eurycea bislineata bislineata* (Green)

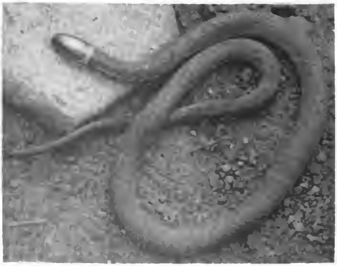


Figure 2 Example of a reptile. Ring-neck Snake, *Diadophis punctatus edwardsii* (Merrem)

The amphibians are timid and inoffensive. Some, as the toad, are beneficial because of the noxious insects, slugs, etc., that they destroy. Many frogs are edible. The Mudpuppy is also edible, the flesh having a flavor much like that of frogs. Most of the snakes are timid and seek only to escape when disturbed. A few, the Water Snake and Garter Snake among them, are harmful when under certain conditions they kill too many valuable food fishes and toads. Some turtles are scavengers and a considerable number are highly valued as food.

Breeding Habits

The amphibians of the park hatch from eggs which, in the majority of cases, are deposited in water. The manner of deposition varies somewhat in different species as indicated in the following paragraphs:

Salamanders. The eggs may be deposited singly and attached to the lower surface of a support in water, (Red Salamander, Two-lined Salamander and Mudpuppy); attached singly to plants, bottom rubbish etc. (Newt); in large globular masses (Spotted Salamander); in long rosary-like strings (Hellbender); clustered to the lower surface of a support in water (Purple Salamander). Of the salamanders that deposit their eggs in drier situations, disposition is made as follows: In little grapelike clusters in rotten wood (Red-backed Salamander); in clusters in damp situations beneath logs, rotting leaves or in rotten wood (Dusky Salamander, Allegany Salamander). The eggs of the Slimy Salamander have never been described.

Frogs and toads. The eggs of the common toad are deposited in long twisted strings attached to submerged vegetation, twigs etc., or simply dropped on the bottom of the pond or pool; the eggs of the Spring Peeper are attached singly to plants or bottom rubbish; the Tree Toad lays its eggs in little clusters at the surface of the water; the eggs of the Bullfrog and Green Frog are spread in broad surface films; the Wood Frog, Pickerel Frog and Leopard Frog deposit their eggs in large masses.

The globular egg-masses of the Spotted Salamander have a thick external layer of jelly and in this respect they differ from the eggs of those frogs that also deposit large masses (figures 3–4).

Fertilization is internal in all the salamanders except the Hellbender and external in the frogs and toads. In the reptiles fertilization is internal. All the turtles and some of the snakes hatch from eggs laid on land. Certain snakes bring forth their young alive.

Viviparous (producing living young)	*Oviparous (egg-laying)*
Water Snake	Ring-neck Snake
DeKay's Snake	Green Snake
Red-bellied Snake	Milk Snake
Butler's Garter Snake	Pilot Blacksnake
Ribbon Snake	
Garter Snake	
Timber Rattlesnake	

In the viviparous snakes listed above all the dorsal scales are keeled; the oviparous snakes, except the Pilot Blacksnake, have the dorsal scales smooth. The latter has the scales of the sides smooth while those along the middle of the back are slightly keeled. If only the species in the park are considered, the scales are an index to the method of reproduction (figures 5–6).

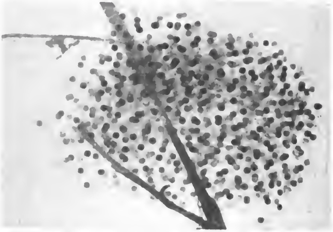


Figure 3 Egg mass of the Wood Frog, *Rana sylvatica* Le Conte. The eggs are provided with individual envelops but there is no common covering of jelly. Photograph by A. H. Wright

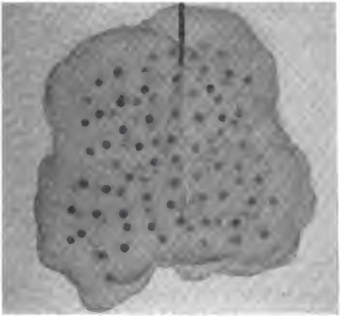


Figure 4 Egg mass of the Spotted Salamander, *Ambystoma maculatum* (Shaw). The eggs are provided with individual envelops and a common covering of jelly. Photograph by E. J. Stein

Frogs, toads and certain salamanders abandon the eggs after depositing them. In the case of the Mudpuppy, Red-backed Salamander and some others, the female guards the eggs until the young have hatched and sometimes longer. With the Hellbender, the male is the guardian parent. Turtles usually abandon the eggs immediately after burying them. Most snakes show little interest in their eggs but occasionally the Milk Snake may be found coiled about her clutch. The young of viviparous snakes apparently do not remain long with the mother.

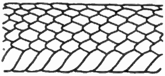


Figure 5 Dorsal scale smooth

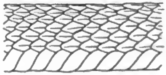


Figure 6 Dorsal scales keeled

Feeding Habits

Adult frogs and toads are largely carnivorous; their tadpoles mainly herbivorous. Both larval and adult salamanders are carnivorous in most instances or, as in the case of the Hellbender, sometimes scavengers. The snakes are carnivorous and often cannibalistic. Turtles with the exception of the Wood Turtle are mostly carnivorous and often scavengers. The Wood Turtle is omnivorous.

Reaction to Light

Of the amphibians many salamanders are nocturnal during most of the year. The Newts are active throughout the day and several species are diurnal during the breeding season. Frogs are most active during daylight hours but in the breeding season may continue their calling and mating throughout the night. Reptiles are found in greatest numbers on bright sunny days but certain of the aquatic turtles also feed at night. On warm nights the Rattlesnake often ventures abroad.

Protection from Enemies

The smaller salamanders are, generally speaking, secretive species which spend most of their lives hidden beneath logs and stones. They escape their enemies by hiding, burrowing and swimming. The terrestrial Red-backed Salamander when roughly grasped drops its tail and leaves it wriggling on the ground to attract the attention of the enemy. The skin of many salamanders is provided with glands which secrete a milky fluid, acrid and exceedingly sticky. Frogs are active and often escape by leaping. Some, as the Pickerel Frog, pour out an ill-smelling fluid when handled. The tree Frog, *Hyla versicolor,* changes its color to match its environment and thus often escapes detection. The common toad is inconspicuous against the soil in which it burrows and is further protected by an acrid secretion of the dermal glands. Many harmless snakes rely on their speed to escape their enemies. Some, as the Water Snakes, are not only aggressive when cornered but pour forth a vile-smelling secretion when handled. The Rattlesnake has its fangs and poison-secreting glands. The Wood and Pond-Turtles are well protected by their shells. The Snapping Turtle has strong, sharp-edged jaws and a short temper. The Musk Turtle also bites and is otherwise protected by the secretion of glands which gives it its characteristic odor.

HABITATS OF AMPHIBIANS AND REPTILES IN ALLEGANY STATE PARK.

The attempt is here made to indicate in a general way the preferred habitats of the amphibians and reptiles found in Allegany State Park. This treatment will serve, first, to indicate where these animals are likely to be encountered in greatest numbers and, second, to bring together the species having similar requirements. Except where the requirements of a species are very exacting, as in the case of the egg-laying Mudpuppy, it is not to be expected that every individual and species will be found at all times under the exact conditions described. Amphibians and reptiles are capable, to some extent at least, of adapting themselves to rather extreme changes in environment, changes that would prove fatal to most of the more highly organized birds and mammals. A case in point is the adult Newt, which is normally aquatic but in times of drouth may survive for months with only sufficient moisture to keep the skin from drying out. Another striking example is furnished by the Snapping Turtle. It is almost strictly aquatic except during the brief period of egg-laying but will live with only enough water to satisfy its thirst.

With many amphibians and reptiles there are also seasonal changes of habitat which may be profound. The Wood Turtle spends the summer months in the woods or meadows and the winter, in many cases, in the mud of the stream bottom. Leopard and Pickerel Frogs take to the fields for the summer and hibernate in springs or streams during the winter. The Spotted Salamander after a summer spent under logs and stones buries itself deeply for the period of cold weather. The arboreal Tree

Frog also hibernates under ground. Even such strictly aquatic species as the Mudpuppy and Hellbender change their habitats within the limits of the stream, seeking the shallows for the egg-laying season and resorting to deeper pools for the winter.

Temporary changes of habitat are common among amphibians and are often associated with the breeding habits. Such terrestrial species as the Spotted Salamander, American Toad, Tree Frog, Spring Peeper and Wood Frog all resort to the water to deposit their eggs and remain in and about it for some time. The aquatic turtles, on the other hand, come out on land when ready to deposit their eggs. The strongly aquatic Red Salamander wanders abroad on summer nights and, when overtaken by the sun, hides beneath logs and stones.

There are, in fact, so many factors to be taken into consideration in any discussion of the habits of amphibians and reptiles that it is usually not profitable to attempt to draw hard and fast lines. The most the field zoologist can be expected to do is to indicate where the various species have been taken, where they are likely to be found and where, in his experience, it would be a waste of time to search for them.

The Wooded Areas

Wooded areas have a bearing on the distribution of aquatic salamanders and certain other amphibians only as they may affect the temperature and water level of streams and the permanency of pools and ponds. On the other hand, such terrestrial forms as the Red-backed Salamander, the Wood Frog and the Wood Turtle are found in greatest numbers where conditions of moisture and shade are maintained by trees (figure 7).

Most of the areas in the park now wooded have been cut over at one time or another so that second growth timber predominates. In two sections are stands of big timber, one in the Big Basin at the source of Stoddard creek and the other at the headwaters of Red House run in the southeastern corner of the park. Here primitive conditions largely prevail. In the park the same species of amphibians and reptiles are found in both types of forest with no decided preference shown for either. The requirements of the Red-backed Salamander are met when fallen logs and leaf mold are present. The Wood Frog thrives in the big timber and in the more open woodlands. The Wood Turtle may be found in the woods or open meadows during the summer and in or along the streams in early spring, late fall and winter. The Slimy Salamander, another strictly terrestrial form, may live in the wooded ravines under logs and stones or in the shale bank of a road-cut in the open.

Of the more strictly aquatic salamanders, the Purple Salamander is found both in woodland streams and the open springs and meadow brooks. In the park the Red Salamander has been found only in the springs and streams in the woods. The Dusky and Allegany Salamanders are more numerous along woodland streams than in the open. The American Toad, while commonly met with in the woods also habitually lives in clearings and meadows, gardens and fields. DeKay's Snake and the Red-bellied Snake, which spend most of the daylight hours hiding beneath logs and stones, were perhaps woodland species that have been able to adapt themselves to changing conditions and are often found beneath sheltering objects in the open. This also applies to the Ringneck Snake. The Timber Rattlesnake, as its name im-

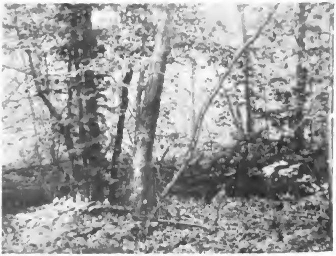


Figure 7 Maple and beech forest with undergrowth and rotting logs. Habitat of Red-backed Salamander, Wood Frog and Wood Turtle. Photograph from Roosevelt Wild Life Experiment Station

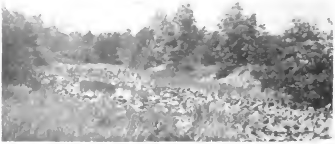


Figure 8 Bayou in the Tunungwant valley. Habitat of the Bullfrog and Green Frog, Snapping and Musk Turtles and various pond-loving species. Photograph by Saunders from Roosevelt Wild Life Experiment Station

plies, was originally a species of wooded rocky hillsides and still shows a preference for this type of habitat. The Spring Peeper and the Tree Toad take to the woods after the breeding season and spend the summer in and about the trees and undergrowth. The red land stage of the common Newt is also spent in the woods and a preference is shown for cool damp ravines.

Backwaters and Bayous

Although there are no natural ponds or lakes within the park, nevertheless suitable habitats for certain pond dwelling species are found in the backwaters of Tunungwant creek and to some extent in the stream itself (figure 8). Here in the quiet waters are found the Snapping, Musk and Painted Turtles, Newts, Bullfrogs and Green Frogs and, in the proper season, Spotted Salamanders and toads which seek such situations for egg-laying. Water Snakes also occur here and along the boggy margins toad-hunting Garter Snakes. Except in the case of such strictly aquatic species as the Snapping Turtle, Musk Turtle and Bullfrog, the forms found here are likely to be encountered elsewhere in the park where conditions are at all suitable.

The Allegheny River and the Larger Creeks

Large streams such as the Allegheny river, Tunungwant creek and Quaker run in its lower reaches, provide suitable environments for certain strictly aquatic amphibians that are not found elsewhere in the park area. The river and stream bottoms where covered with large flat stones, stranded logs or shelving rocks, are the homes of the Hellbender and the Mudpuppy. Such a habitat is little influenced by external features—woods, hills etc.—except as the former may furnish stranded logs and the latter rock fragments for the bottom. Food is abundant in the form of fish and their eggs, crawfish, insects and their larvae and worms. When the smaller streams are examined certain species will be found in greatest numbers where the woods give abundant shade while others will be largely confined to sections flowing through open fields and meadows.

It is perhaps significant that the larger aquatic amphibians are to be found in the larger streams. The Hellbender and Mudpuppy which seek comparatively shallow water for the egg-laying period, nevertheless choose situations that are not likely to be exposed by the lowering of the stream level. The smaller meadow and woodland streams do not provide suitable quarters in sufficient numbers to attract these animals and are consequently not occupied.

In the quiet pools of these larger streams the Painted Turtle, Snapping Turtle, Green Frog, Bullfrog and Water Snake also occur.

Meadows and Pastures

Meadows and pastures are the summer ranges of several amphibians and reptiles. Pickerel and Leopard Frogs migrate to the fields after the egg-laying season and spend the warmer months among the low vegetation; toads seek the shade of rank weed patches; Spotted Salamanders often hide beneath stones and rotting logs in the open and make long journeys to and from the breeding waters. Several species of snakes are often encountered in meadow lands although their original habitat may have been the woods. This is true of the Red Bellied Snake, DeKay's Snake, and to some extent the Ring-neck Snake. Either in woods or meadows they are most often discovered hiding under old bark, logs or stones. Along the streams the Garter and Water Snakes abound. Milk Snakes haunt the open fields in search of mice.

Smaller Streams, Brooks and Runs

The smaller streams near their sources in the wooded hills furnish a type of habitat different from that found in sections of the same streams where they flow across open meadows and flats. Where the streams flow rapidly over steep rocky beds as in Slide hollow, the upper reaches of Stony creek, Dry run and Quaker run, there are found such mountain brook forms as the Purple, Dusky and Two-lined Salamanders. The Purple Salamander follows the stream to its source in some hillside spring and is perhaps most abundant in such situations. The Dusky Salamander is a species of the brook margin, where in the saturated soil it lives beneath logs and stones. The Two-lined Salamander also lives under stones at the water's edge and rushes into the water when disturbed. None of these salamanders, however, is confined to the rapid flowing sections of the streams and none depends entirely on deep shade, although both the Dusky and Allegany are more numerous in the woods than in the open. In the rapid sections of the streams we do not expect to find many of the frogs, turtles or snakes although individuals turn up from time to time.

Where the smaller streams flow through comparatively level open woods and meadows the Leopard and Pickerel Frogs, in their proper season become abundant. In the shallow riffles the Two-lined Salamander may lay its eggs, attaching them to the lower surface of a stone. In the deeper pools, the Green Frogs spend the summer months.

Upland Bogs

Near the Bradford road in the southeastern corner of the park is a rather extensive sphagnum-heath association. Here among the low undergrowth the Smooth Green Snake is likely to be found in greatest numbers and here in the early spring will be discovered the Four-toed Salamander if it occurs in the park at all.

There are no open streams or pools of sufficient size and permanence to attract other bog-loving species and any other forms occasionally encountered may be regarded as casual visitors.

Amphibians and reptiles of various species are so often found in or about rotting logs that some attention should be directed to this prolific source. In some instances the log provides both food and shelter; in many more cases it serves as a temporary retreat. The Red-backed Salamander during the egg-laying season is more likely to be found within the log or beneath the loose bark than in any other situation. The eggs are deposited here in the great majority of cases and are guarded by the female who coils about them. Where the log overhangs a small woodland stream, the Dusky Salamander often deposits its eggs. When in contact with the earth in damp situations a log may hide the burrows of the Red, Dusky, Two-lined or Purple Salamander. As a stranded log in the stream bottom it becomes a nest site for the Mudpuppy.

During the heat of the day frogs often seek the shelter of a log, which serves as a moist retreat. This is particularly true of the meadow frogs, Pickerel and Leopard, which range the open fields and pastures.

Several snakes are more often found within and beneath rotting logs than in any other situation. This is often true of the Red-bellied Snake, DeKay's Snake and the little Ring-neck Snake. Other snakes habitually lay their eggs beneath logs, planks and stones, and in such situations in the park have been found the eggs of the Green and Milk Snakes. Even the Musk Turtle often selects rotten wood of logs and stumps in which to lay its eggs.

ANNOTATED LIST OF THE AMPHIBIANS OF ALLEGANY STATE PARK

Introduction

The following list of Allegany State Park amphibians is based on collections made during August 1926, supplemented by specimens and notes brought together by W. P. Alexander during the years 1921 to 1925. It is believed to be reasonably complete. The presence in the area of each species listed is based on at least one specimen and in most instances on many. In the case of some very common and well-known species only a specimen or two was taken but enough individuals were examined to insure proper identification and to give some idea of the distribution within the park.

Under each species a few brief notes on life history and habits have been given and in preparing these I have drawn freely on data brought together during ten years' collecting experience in various parts of the State. Where my own records were incomplete or lacking, as in the egg counts of frogs and toads, time of emergence, egg laying etc., I have given general statements based on the careful work of Dr. A. H. Wright ('14, '24).

In August 1926 I had the assistance of W. J. Schoonmaker of the New York State Museum for a period of about two weeks, and of others engaged in field work on various natural history problems. Campers and visitors to the park also contributed specimens from time to time and their names as collectors appear in the report under the accounts of various species. Where no collector's name is given, the writer is responsible for the record.

1 **Mudpuppy,** *Necturus maculosus maculosus* (Rafinesque)

Figures 9–10

The Mudpuppy has an average length of about 12 inches, although individuals 15 inches long are not uncommon and giants 17 or 18 inches in length have been reported. The color is generally a deep rust brown with spots of blue-black present on the sides and back. The young to the end of the third year differ from the older specimens in having a dark stripe down the midline of the back, bordered on each side by a narrower line of yellow. Below the yellow line on each side is a broader band of black which fades into the generally lighter belly.

The most striking feature of the animal is its bushy red gills which are retained throughout life. There are three on each side of the neck and when in use are kept in constant motion. They function primarily when the water is warm or the oxygen content is low. Oxygen is also taken into the lungs and directly through the skin.

The Mudpuppy is found in suitable situations the entire length of the Allegheny river within the State, and in some of the larger tributaries. It occurs in greatest numbers where the bottom is covered with flat stones and rocks, logs and wood slabs. Suitable quarters are likely to be found where the river skirts the foot of the mountains and rocks have broken off and slipped into the stream. Where the river crosses wider, open valleys, a few rifts and deeper pools may harbor almost the entire Mudpuppy population for a distance of several miles.

So exacting are the requirements of egg-laying females that by examining the stream bottom the experienced collector may predict with considerable success the presence or absence of specimens. The amount of available

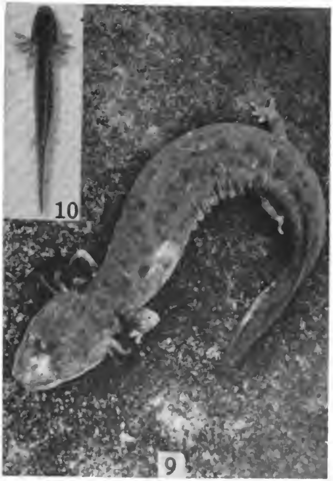


Figure 9 Mudpuppy, *Necturus maculosus maculosus* (Raf.). Adult photographed under water. About one-half natural size. Note the three pairs of bushy gills which are retained throughout life

Figure 10 Inset: Young larva twice enlarged. The light longitudinal stripes are characteristic of the young

food in the stream is a factor governing the abundance of individuals only when the stream provides suitable hiding places and nesting sites. This is strikingly shown in Quaker run (figure 11). From the Pennsylvania Railroad bridge to the junction of the stream with the Allegheny, the water is of suitable depth and the bottom is sandy, gravelly or stony; but there are no flat rocks suitable for nest sites and the Mudpuppy is absent except in migration up or down stream. Above the railroad bridge and extending for a mile or more across the Allegany Indian Reservation and into the park, the stream is plentifully supplied with flat stones and shelving rocks and deeper pools alternating with shallow riffles. Here every shelter suitably imbedded serves as a nest site and the loose surface materials, logs, slabs or rocks give protection to individuals bent on foraging. The young after leaving the nest are usually found in deeper pools of quiet water.

Habits. The Mudpuppy is nocturnal in clear streams and lakes, perennially aquatic and carnivorous. The food consists of fish and their eggs, crawfish, aquatic insects and their larvae, worms, small mollusks and sometimes their own eggs.

All available evidence points to an autumnal mating period for this species. At this season the sexes are found together, the cloacal glands of the males are greatly swollen and the spermathecae of the females have been found to contain active sperms. Furthermore, specimens in captivity have been observed to go through a kind of courtship.

The nests of the Mudpuppy are simply shallow excavations beneath flat stones, boards or logs and the eggs are attached to the lower surface of the covering object. In shallow streams the nests are most frequently found near

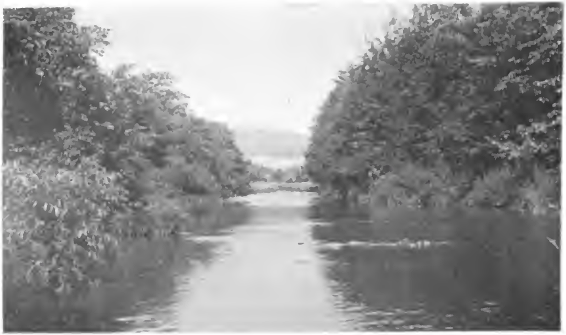


Figure 11 Quaker run near Quaker Indian School. Habitat of the Mudpuppy, *Necturus maculosus maculosus* (Raf.) The large flat rocks partially imbedded in the stream bottom serve as nest sites and retreats

the rifts but not in the fastest water and the entrance is on the downstream side.

During the egg-laying season, which begins in western New York and Pennsylvania during the first week in June, the males are not found on the spawning grounds. The females deposit their eggs to the number of a hundred or more, attaching them one at a time to the sheltering object and remaining with them not only until the young have hatched but in many instances until they have left the nest. It is not improbable that the female may occupy the same nest for several seasons for we have found them at all times of the year, even after the young have departed.

The eggs themselves have a diameter of about one-fourth of an inch and are supplied with envelops and an attachment stalk which give them a total diameter of almost one-half an inch.

Records.—Many specimens taken and observed in Quaker run between the Pennsylvania Railroad bridge and the highway bridge over the run near the entrance of the park August 23, 1926, S. C. Bishop and W. J. Schoonmaker. August 31, 1926, one adult from Allegheny river near mouth of Wolf run. An earlier record for the region was supplied by a specimen taken in the Allegheny on August 15, 1923.

2 The Hellbender, *Cryptobranchus alleganiensis* (Daudin)

Figure 12

The Hellbender is the largest salamander in the western hemisphere and the most striking animal in the park area. In New York State it is entirely confined to the Allegheny river and a few of the larger tributaries except where introduced. Like the somewhat smaller Mudpuppy it is found in the river where rocks on the bottom offer protection and nest sites.

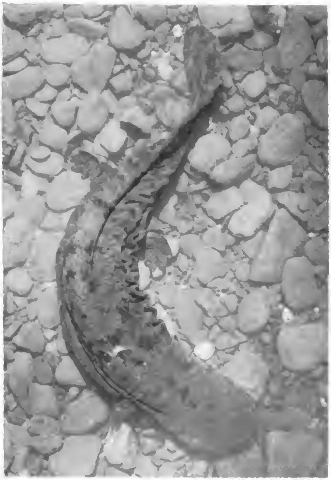


Figure 12 Hellbender, *Cryptobranchus alleganiensis* (Daudin). A young adult photographed under water. About one-third natural size. The wrinkled, fleshy folds on the sides of the body are characteristic

The Hellbender reaches a maximum length of 27 inches but the average adult is nearer 16 to 18 inches. The color is variable, shading from light brown and rust-red to dark brown and black. Many individuals are strongly spotted with dark and lighter patches and vary in color under different conditions. The body is broad and flat with well-developed fleshy folds along the sides and on the hind margins of the legs. Of peculiar interest are the gill slits, usually persistent, one on each side of the throat. The eyes are extremely small. While the Hellbender has not been found within the park itself, it follows the Allegheny its entire length within the State, enters Oswayo creek near the Pennsylvania line and will undoubtedly be discovered in Tunungwant creek and other large streams. In the Allegheny we have taken it in numbers near the mouth of Wolf run (figure 13). Here the river cuts the base of Elko mountain and the bottom is covered with flat rocks and stones, stranded logs and cross ties. It is easily captured with a dip net by turning flat rocks during periods of low water.

It is absent or rarely taken in those parts of the river that have the bottom covered with sand, gravel or small rounded stones but with no flat rocks and stranded logs. Here again, as in the case of the Mudpuppy, the abundance of individuals does not so much depend on the amount of available food as on suitable retreats.

Habits. The Hellbender is entirely aquatic and generally nocturnal but at times may be observed moving slowly about over the bottom during daylight hours. It becomes more active as dusk approaches and after dark forages among the rocks of the stream bottom, poking its head into crevices and forcing its way under logs and stones. Sometimes it rests beneath some shelter with only

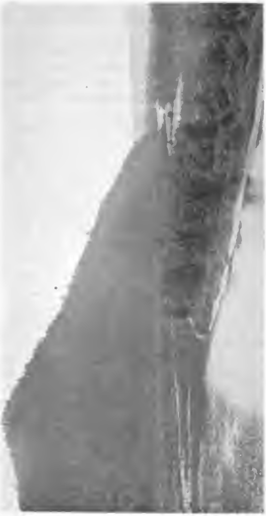


Figure 13. Allegheny river at Wolf Run Station. Elko mountain in the background. Habitat of the Hellbender. The rocky bar extending into the river is at the mouth of Wolf run. North of this bar the water is shallow along shore and Hellbenders may be found beneath the flat rocks. Photograph from Buffalo Society of Natural Sciences

the head thrust into view. The food consists largely of fish, crawfish, mollusks, worms, insects and larvae, animal refuse of almost any character and its own eggs.

At the approach of the egg-laying season which in western New York and Pennsylvania begins about September 1st, the males may be found occupying definite excavations beneath flat rocks imbedded somewhat in the stream bottom. The "nest" is apparently the work of the male alone and is a basin-shaped cavity provided with an entrance on the downstream side. Once within the retreat the males await the coming of females with ripe eggs. The eggs of a single female number three hundred or more and as several may deposit in the same nest, the entire batch may contain over a thousand. They are laid in strings like the beads in a rosary and have an individual diameter of about one-fourth of an inch, with their envelops almost one-half of an inch. Fertilization is external, the milt being poured over the eggs as they are extruded into the water.

After spawning, the female is driven from the nest and the male takes on the responsibility of guarding the eggs against other males, spent females, Mudpuppies or other enemies. His motives may not be altogether altruistic, however, for in a way he is guarding his own food supply. Fortunately digestion is slow and many eggs are left to hatch.

Records. Allegheny river between mouth of Wolf run and Elko railroad station, August 31, 1926, 7 large ♂ all taken within 15 minutes, S. C, Bishop, W. J. Schoonmaker and Clarence Wagner, coll.; same locality, September 1, 1926, 7 large specimens, 4 ♂ 3 ♀, S. C. Bishop, W. J. Schoonmaker and J. Hofmayr, coll.; Oswayo creek, August 31, 1926, 2 small specimens, S. C. Bishop, W. P. Alexander and A. K. Lobeck, coll.

3 **Newt, Red Eft,** *Triturus viridescens viridescens* (Rafinesque)

Red Eft and Little Red Lizard are names given to the usually immature, red land stage. The Newt is one of the commonest salamanders in the park. There are two distinct forms representing different phases of the life history of the animal, and because they are so strikingly different, they have often been regarded as distinct species. The aquatic adults may attain a length of about four inches, though usually smaller, and are greenish above and yellow below with black flecks scattered over both back and belly (figures 15-17). On each side of the trunk there is a single series of small, bright red, black-bordered spots. The tail is keeled above and below, more strongly in the male than in the female and particularly so during the breeding season. The smooth-skinned adults are found in quiet pools, backwaters of the lowland streams and in the streams themselves where there are quiet stretches. Occasionally they are found on land under bark and logs.

The land form, or Red Eft, varies in color from dull red to bright orange red and averages considerably smaller than the aquatic adults (figure 14). The skin is also rougher and the tail lacks the strong keels. The lateral series of small red spots is present as in the other form. Most red individuals are sexually immature but attain maturity shortly before or after entering the water. The red form is widely distributed throughout the park and is often found wandering over the forest floor in the woods bordering the many streams. They are perhaps most commonly observed after showers and may be collected in numbers in the cool ravines.

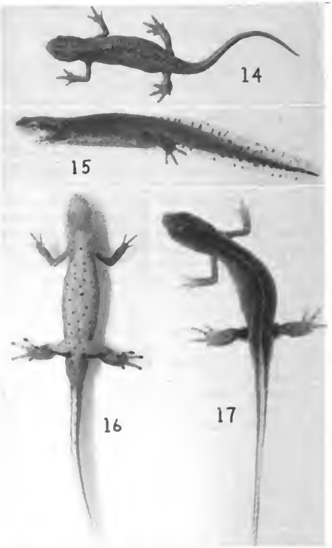


Figure 14 Newt, *Triturus viridescens viridescens* (Raf.) Eft or red land stage. Note rough skin and lack of strong tail keels. Figure 15 Aquatic adult, male Note broad tail keels. Figure 16 Male showing horny excrescences on thighs and hind toes. Figure 17 Male. The heavy hind legs and dorsal tail keel are evident. All figures natural size

Habits. The adults are active throughout the day and may be observed leisurely swimming in the open water, crawling slowly over the bottom or floating at the surface with the nose out of water and legs outspread. They are carnivorous and eat almost anything of an animal nature that can be captured and swallowed. The chief food consists of worms, insects and their larvae, tadpoles of frogs and toads, small crustaceans and mollusks. On one occasion I found them gorging themselves on the eggs of the Mink Frog, *Rana septentrionalis*. In captivity raw meat, liver or earthworms are taken readily.

There is a fall mating period which may be continued sporadically through the winter. The males develop black, horny excrescences on the tips of the toes of the hind feet and on the lower surface of the thighs and even deposit spermatophores but, so far as known, the females do not deposit eggs until spring. Actual mating begins in March or April and may continue to July. The male has the nuptial excrescences developed to the highest degree, goes through his mating antics and deposits spermatophores, which are small, vase-shaped masses of jelly surmounted with clusters of sperms. Fertilization is internal, the female taking up the sperms and storing them in receptacles in the cloaca until the eggs are laid.

Following the spring courtship, the female deposits her eggs singly in the axils of the leaves of aquatic plants or on the leaves themselves, to which they adhere closely. In most instances the leaves are drawn together between the hind legs of the female so as to conceal the egg and the gelatinous egg capsule holds them in place. As many as 80 to 90 eggs may be developed in a season and are deposited over a rather long period.

The eggs are spherical and have a diameter of 1/16 (1.5 mm) of an inch; with their gelatinous envelops, which are elliptical, the total dimensions are about 1/10 by 1/7 inches (2.5 by 3.5 mm). The upper pole of the egg is dark brown, the lower pole light green.

The larvae at hatching are less than half an inch long and are provided with short "balancers," gills, and the buds of the fore legs. The hind legs develop somewhat later. The larvae begin to transform in late summer, losing their gills and tail keels as they take on the characters of the land form. How long the red form resides on the land before returning to the water has never been definitely established. In some parts of its range this period is probably shortened to the winter following transformation.

Records. During the three-year period the Buffalo Society of Natural Sciences maintained its field museum at the Allegany State Park, Newts were constantly being brought in from pools and woods and from Quaker and English runs, Stony and Coon creeks; Quaker run near Frecks, August 3, 1922, several specimens; Quaker run near Frecks, August 1923, six specimens, W. P. Alexander, coll; Butler's run, August 5, 1926, 1 Eft; Frecks, August 10, 1926, 1 Eft; Butler's run, August 15, 1926, 1 adult; Buffalo camp, August 16, 1926, 1 Eft; Blacksnake mountain, August 17, 1926, 1 adult, 109 mm long, in open woods (not in water); Frecks, August 18, 1926, 1 adult; August 23, 1926, 1 adult; August 27, 1926, 1 adult; Camp Turner, August 25, 1926, 1 large specimen with rough skin and other characters of Eft; Frecks, August 21, 1926, 1 adult.

4 Spotted Salamander, *Ambystoma maculatum* (Shaw)

Figure 18

The average length of the adult Spotted Salamander is about six inches but exceptional individuals will reach seven and a half inches. The body is stout with well-developed feet and legs. The general color above is black with a series of large, round, yellow or orange spots

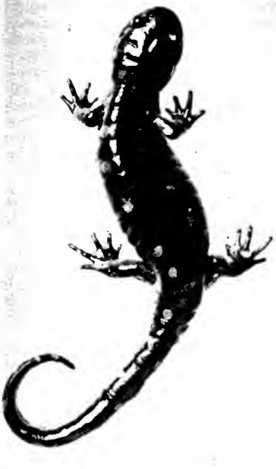


Figure 18 Spotted Salamander, *Ambystoma maculatum* (Shaw). An adult female about natural size. The light spots are yellow or orange in life. Photograph by J. A. Glenn

along each side. There are about three spots on each side of the head, eight or nine on the trunk and an equal number on the tail. The belly is slate colored.

They are quite generally distributed throughout the park area except on the dry hill summits.

Habits. The adults are terrestrial except during the egg-laying season and in the park are found under logs and stones both in open pastures and woods or in leaf mold where they often burrow to a considerable depth. They are secretive, nocturnal animals and are not found in numbers except in the breeding waters or during migration to them. Sometimes an obstruction such as a deep ditch or railroad track which lies across the line of migration will prevent ready access to the water and the salamanders from a wide area will be concentrated in a comparatively small space.

The food consists of worms, insects, small mollusks, spiders and other small creatures commonly found under logs and in leaf mold.

In late March or early April, depending on temperature and weather conditions, the adults start their migration to the water for the egg-laying season, the males usually preceding the females by a day or so. Small ponds are visited when available but quiet backwaters or still stretches in streams will serve when ponds are not to be found. When the females arrive the males, after a brief courtship, deposit a considerable number of spermatophores, small vase or stump-shaped supports of jelly topped by whitish masses of sperms. Fertilization is internal, the females taking the sperms into the cloaca and storing them in little pouches in the dorsal wall until the eggs are laid.

The eggs to the number of two hundred or more are deposited in several large masses attached to submerged twigs, grass stems or the leaves of aquatic plants (figure 4). Individual eggs are spherical and have a diameter of about 1/10 of an inch (1.5 mm) and are inclosed in little jellylike envelops within the common covering of thick jelly which entirely surrounds the mass. The larvae, which hatch in two to four weeks, depending on water temperature, are about one-half inch long. "Balancers" are present as well as gills and the elongated buds of the fore legs. The tail is broadly keeled, and above is continued along the back to the head. The larvae begin to transform in July and may continue until October. The yellow spots are acquired soon after transformation.

Records. Stony creek, July 9, 1921, 2 transforming young with gill rudiments, W. P. Alexander, coll.; Mount Onondaga, August 9, 1922, 1 adult from rotten log; W. P. Alexander, coll.; Red House creek, August 12, 1922, a small specimen with gill rudiments, W. P. Alexander, coll.; hillside between Willis and Coon creeks, August 10, 1926, 1 adult; Balsam swamp, Red House Valley, August 13, 1926, 1 adult; Tunungwant valley near Limestone, August 22, 1926, 1 adult under log on stream bank; Buffalo Camp, August 21, 1926, several larvae. Specimens of the Spotted Salamander were being constantly brought to the park museum, 1921 to 1923, W. P. Alexander.

5 **Red-backed Salamander; Lead-backed Salamander** (names given to the two color phases) *Plethodon cinereus* (Green)

Figure 19

The Red-backed Salamander is the most terrestrial species in the park and with the exception of the Newt is probably found more often than any other species. They are most numerous in the wooded areas where rotten logs and stumps provide food and shelter and may even be found on the extreme summits of the mountains where suitable conditions prevail.

There are two distinct color phases: the typical form, dark gray with a broad, red, dorsal band, and the so-called "Lead-backed" form in which the red is absent or only slightly developed. In any large series of specimens, individuals will be found that are intermediate in color. Both forms have been found in the park, although the red-backed individuals are more abundant.

This species reaches the length of about three and one-half inches. The body is quite slender and wormlike with small and slender legs and a round tail.

Habits. Red-backed Salamanders are strictly terrestrial throughout the year and may be found in or beneath rotten logs, under stones or in the leaf mold of the forest floor. They are nocturnal and when exposed to the light seek to escape it by hiding or burrowing. In spite of their slender legs they are quite active and progress not only by walking but by vigorous contortions of the whole body which carry them forward rapidly.

The food consists of insects and larvae, worms, snails, spiders, and other forms of animal life.

Egg laying may start as early as the middle of June and continue for several weeks. At this time females may be found guarding their eggs in rotten logs or stumps or, more rarely, beneath stones in woods. They are most abundant in logs that have decayed enough to be pulled apart with the hands.

The eggs are clustered together like a small bunch of grapes and are attached by a slender pedicel to the top of the cavity chosen by the female for her retreat (figure 20). The female is usually found in contact with the eggs, protecting them and keeping them moist. From three to twelve eggs may be found in a cluster but the average is about six. The individual eggs with their envelops vary in size from 1/8 to 3/16 of an inch (3.5 to 4.5 mm).

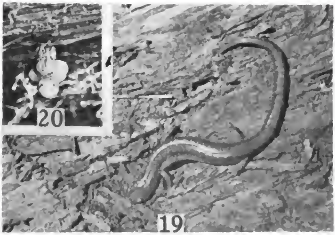


Figure 19 Red-backed Salamander, *Plethodon cinereus* (Green). An adult specimen in which the red dorsal band is only slightly developed. Figure 20 Inset: Eggs of the Red-backed Salamander photographed in a crevice of a rotten log. Photograph of eggs by D. J. Leffingwell

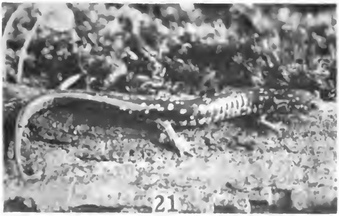


Figure 21 Slimy Salamander, *Plethodon glutinosus* (Green). An adult specimen about two-thirds natural size. The light spots on the sides and back are bright silvery white in life

The larvae, which usually hatch in August or early September, are about three-quarters of an inch in length and sometimes possess gills which are retained for a day or two. In others the gills are lost before the young break out of the egg envelops.

Records. Recorded as very common in the park from 1921 to 1925 by W. P. Alexander in charge of the field museum of the Buffalo Society of Natural Sciences. Coon creek, August 3, 1922, 7 adults, J. Borst, coll.; on hillside between Willis and Coon creeks, August 10, 1926, 3 adults, one of which was a female guarding her eggs; Blacksnake mountain, August 17, 1926, 2 females guarding eggs containing well-developed embryos; Tunungwant creek valley near Limestone, N. Y., August 22, 1926, 2 adults; Seneca mountain, August 24, 1926, 1 adult, W. J. Schoonmaker, coll.; Mount Cayuga (summit), August 29, 1926, 1 adult, J. Hofmayr, coll.

6 **Slimy Salamander,** *Plethodon glutinosus* (Green)

Figure 21

The Slimy Salamander reaches an extreme length of about seven and one-quarter inches but the average adult is nearer six inches. The color is a deep blue-black speckled on the sides and back with small silvery white spots. The tail is cylindrical and usually free from the light spots on the hind third. In some individuals the white spots on the sides tend to run together to form irregular but quite distinct bands.

They are quite generally distributed in the park in the wooded areas and are perhaps most abundant in the shady ravines, where they live beneath logs and stones. They are also found in places where there is little apparent moisture but always there is access to burrows in the soil or crevices in banks.

Habits. In common with most of the salamanders, this species is nocturnal. Following a rain it is likely to be found along roads or streams where the banks have been cut away exposing little crevices in the rocks or shale. Here by night they may be seen resting in the mouths of the burrows or crawling slowly over the surface in search of food.

When handled roughly, the dermal glands, most abundant on the tail, pour out a sticky secretion which may cover the surface of the skin with whitish drops.

The food consists of insects of various kinds and their larvae, small worms, spiders, millipedes and other small creatures.

The eggs of this species have never been described and it is doubtful if they have ever been discovered although one writer speaks of small embryos taken from eggs. In all probability the eggs of some other species were under observation.

Small specimens about one inch long have been found early in summer and females with large eggs in the body have been collected in December, so it is likely that the eggs are deposited in late winter or early spring in deep crevices of shale or rock where many individuals spend the winter.

Records. Slide hollow, July 29, 1921, 3 adults, Ed. Green, coll.; Willis hollow, July 7, 1922, 1 adult, W. P. Alexander, coll.; Indian Reservation near Quaker School, August 3, 1922, several adults, W. Wild, coll.; Coon creek, August 3, 1922, 4 adults, J. Borst, coll.; near Halls, Red House valley, August 12, 1923, 5 adults, W. P. Alexander, coll.; hillside between Willis and Coon creeks, August 10, 1926, 2 adults; Tunasassa, Allegany Reservation near river, August 19, 1926, 2 adults; Stony creek, August 19, 1926, 2 adults; Seneca mountain, August 24, 1926, 1 adult, W. J. Schoonmaker, coll.

7 **Purple Salamander,** *Gyrinophilus porphyriticus* (Green)

Figures 22, 24

The Purple Salamander has been regarded as one of the rarer species but in suitable situations in the Allegany State Park it is very common. The color of adult specimens is light reddish or pale salmon with indistinct darker reticulations on the back and sides. The belly is light. From the eye a light line runs to the nostril. Large individuals reach a length of seven and one-half inches but the average is nearer six inches.

In the park this salamander is found chiefly in the clear springs or streams near their sources or in the smaller tributaries of mountain creeks (figure 24). Breeds run where it passes through the State Forest Experiment Station woods offers ideal conditions. Here the species is found in numbers under flat stones in the stream bottom or under logs that are partially imbedded either in the stream or the mud of the swampy areas. They are also found in the small streams flowing from springs on the hillside above the Balsam swamp in Red House valley. Here the streams flow across open hillside meadows but because the requirements of the species are met—cold water, shelter and food—the absence of forest has not caused them to disappear. Altogether there is a decided preference for the smaller streams and it is generally useless to search the larger ones.

Habits. The species is essentially aquatic and the adults are found either in the water itself or beneath stones or logs that lie in close proximity. Occasionally a specimen may be found under shelter some distance from the nearest stream but this is exceptional. The larvae are entirely aquatic but at the time of transformation may lie with the head and body partly out of the water if they are beneath some protecting log or stone.

Eggs supposedly of this species have been reported. They were found in a spring, August 8, 1924, near Indiana, Pa., and were clustered to the lower surface of a stone. Eggs with their envelops measured about three-eighths of an inch (9 mm) in diameter.

The larvae vary in length from one inch to four and one-half inches and evidently three or more years are required to reach maturity.

Records. Slide hollow, June 22, 1924, 2 adults, S. C. Bishop and B. S. Bronson, coll.; Slide hollow, August 10, 1926, 6 larvae, S. C. Bishop and W. P. Alexander, coll.; Hillside above Balsam swamp, Red House valley, August 13, 1926, 6 adults, 8 larvae; Breeds run, August 18, 1926, 7 adults (1 just transformed), 1 larva; Stony creek, August 19, 1926, 1 adult, several larvae; Red House run (upper end) August 25, 1926, 1 adult.

8 Red Salamander, *Pseudotriton ruber ruber* (Sonnini)

Figures 23, 25

The adult Red Salamander is the most brilliantly marked species in the park area. The color of recently transformed individuals is a bright coral red with numerous small, round black spots scattered over the back and upper sides. The belly is flesh color. In old specimens the spots tend to fuse and the ground color becomes darker, varying through shades of brown, dark red and purple. The largest adults reach a length of six inches but transformed specimens are sometimes found that are only half that length. The average size is about four and one-half inches. This is one of the rarer species of the area and has been found only twice, both times in the roadside woods near the bridge which crosses Quaker run a short distance south of the Quaker Indian School. Here there are small, spring-fed streams which flow through a low swampy area in the woods.

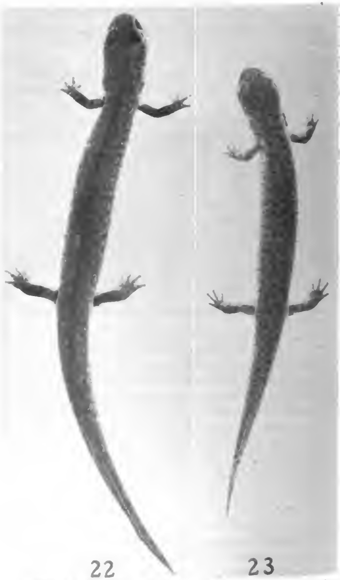


Figure 22 Purple Salamander, *Gyrinophilus porphyriticus* (Green). Adult specimen about natural size. Note light line from eye to nostril Figure 23 Red Salamander, *Pseudotriton ruber ruber* (Sonnini). A young adult about natural size

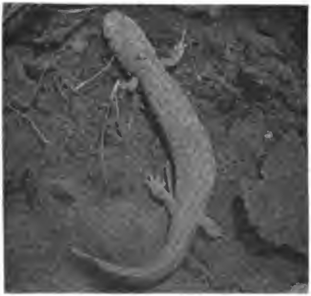


Figure 24 Purple Salamander, *Gyrinophilus porphyriticus* (Green). An adult photographed on the bottom of a small pool. About two-thirds natural size

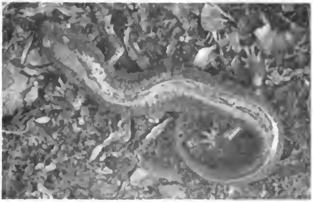


Figure 25 Red Salamander, *Pseudotriton ruber ruber* (Sonnini). An adult specimen in which the dark spots tend to run together. About two-thirds natural size

Habits. The Red Salamander is usually found in springs or in streams that are spring-fed. Their requirements are not exactly those of the Purple Salamander, although both species are sometimes found together. The Red Salamander often lives in streams or springs that are filled with dead leaves or other rubbish and that have muck or mud bottoms. In such situations the Purple is not likely to be found. The adults are often found occupying excavations beneath logs or stones by the side of a stream or spring and usually there is a definite tunnel leading down into the water. Occasionally they may wander a considerable distance from water and hide under logs or bark or stones in the woods (figure 25). They are nocturnal and carnivorous. The food consists of insects and their larvae, worms, small crustaceans and other salamanders.

In the northern part of the range the eggs are laid in the fall. They are attached separately to the lower surface of stones imbedded in the spring bottom where the coldest water bathes them as it bubbles from the ground. They hatch in early winter and the young larvae subsist on the yolk supplied in the egg until they are able to shift for themselves.

At hatching the larvae are only a little over half an inch long. By April or May of the spring following they reach a length of about one inch and are able to capture food consisting of small crustaceans and insects. The color is distinctly different from that of the adults, being pale dull brown with darker specks. The red of the young adult is gradually acquired during the period of transformation. At least three years are spent as larvae.

Records. Woods near bridge crossing Quaker run not far from entrance to park, August 3, 1922, 1 small red specimen, W. Wild and W. P. Alexander, coll. A second specimen was taken in the woods on the opposite side of the road.

9 The Two-lined Salamander, *Eurycea bislineata bislineata* (Green)

(See Figure 1)

The Two-lined Salamander is the smallest and most slender species found in the park. The ground color varies from pale straw to bright yellow and on each side of the back there is a narrow black line extending from the eyes onto the tail. Below the dark lines the sides are usually finely speckled with black and there is often a line down the middle of the back which may be continuous or broken into separate dots. The belly is yellow and without dark markings. The tail is flattened, a character which distinguishes it from some specimens of *Desmognathus fuscus ochrophaeus* which somewhat resembles it. Large specimens reach a length of about three and one-half or four inches but the majority of those collected are smaller.

This species is very common in many parts of the State but is apparently rare within the park, although suitable situations do not seem to be lacking.

Habits. As an adult it is primarily an animal of the smaller stream borders where it hides under logs and stones at the water's edge. It is also to be found beneath stones in the bed of streams, in shale and gravel banks where there is seeping water and not infrequently under bark, logs, or stones in the woods. The greatest number of specimens will be found not in the water itself but where the soil under stones and logs is thoroughly saturated with water. This is one of the few salamanders that may be found foraging by daylight on the stream bottom. The chief items in the diet are small insects, worms, crustacea, spiders and millipedes.

Eggs of the Two-lined Salamander have been found as early as April and as late as the latter part of August. They are deposited separately on the lower surface of stones in the streams or springs and may number as many as 68. The average complement, however, will have about half as many. Individual eggs have a diameter of about one-tenth of an inch (2.5 mm) and with the envelops about one-sixth of an inch (4 mm). The outer envelop is drawn out to form an attachment ring which adheres to the supporting stone and permits the egg to hang free in the water. The newly hatched larvae are about one-half an inch long and extremely slender. They reach a length of about two inches before losing the gills and are at least two years old at transformation.

Records. Quaker run, July 6, 1921, 1 adult, W. P. Alexander, coll.; Coon creek, August 3, 1922, 1 adult, W. P. Alexander, coll.; Seneca mountain, August 17, 1926, 1 adult under log in woods; Buffalo Camp, August 22, 1926, 1 adult under a log in dry situation.

10 **Dusky Salamander,** *Desmognathus fuscus fuscus* (Rafinesque)

Figures 26, 27

The Dusky Salamander reaches a length of about four inches but the majority of specimens captured are considerably smaller. The color above is dark brown, quite uniform in some, in others mottled with a series of black-edged blotches forming a broad dorsal band with irregular edges. Still others have the broad band down the back somewhat lighter but with dark edges. The sides are grayish brown with the color gradually fading into the dull white of the belly. There is a short light line running from the hind corner of the eye to the angle of the jaw.

The tail is roughly triagonal in shape at about half its length and from that point to the tip is more strongly flattened and keeled above.

In the park these salamanders are everywhere common along streams and in the wet places about springs, where they hide under any available cover. They are often concentrated in low spots in the beds of brooks that have nearly run dry. Here under logs and stones or rotting leaves they burrow extensively, their retreats leading to the water below the surface.

Habits. While this salamander can not be regarded as strictly nocturnal, it is not often seen during daylight unless exposed by having its retreat uncovered. Often it lies for hours out of water in protected places where it can seek safety at the slightest disturbance. Its burrows in soft yielding soil ramify in every direction, some branches leading to water, others to the surface entrances beneath a log or stone.

While it is usually found in wet places and does not hesitate to swim freely in open water, it is not strictly aquatic except in the larval stage.

The Dusky Salamander is carnivorous, the diet being composed of insects, worms, snails, small mollusks, crustaceans and other salamanders.

The egg-laying season extends over a period of several months and the eggs or embryos may be found from June well into September. The eggs are deposited in a great variety of situations, in little cavities beneath stones or logs, in wet moss in low boggy places, in rotten logs on the banks of streams or beneath damp leaves in the beds of little woodland streams gone dry. The female is usually found coiled about her eggs, protecting and keeping them moist (figure 27). They are deposited in

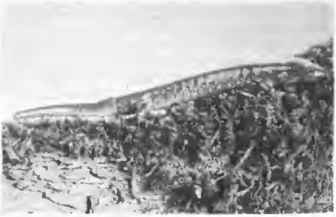


Figure 26 Dusky Salamander, *Desmognathus fuscus fuscus* (Raf.). Adult about natural size but with tip of tail lost. Photograph by E. J. Stein

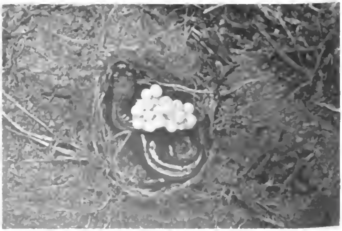


Figure 27 Dusky Salamander, *Desmognathus fuscus fuscus* (Raf.). A female and her eggs in a little "nest" exposed by turning over a flat stone

small clusters containing from 12 to 20, joined by extensions of the outer envelops. In color they are dull yellowish white and vary in size from about one-eighth to one-sixth of an inch (3 to 4 mm) in diameter. About two months are required for development under natural conditions and the larvae attain a length of about half an inch while still within the egg envelops. They persist as larvae about nine months.

Records. During July and August 1921 many specimens were brought to the Buffalo Society of Natural Sciences field museum from streams near Buffalo, Creekside and Fancher camps. Seneca mountain, August 30, 1921, 1 adult, W. P. Alexander, coll.; Coon creek, August 3, 1922, 3 adults, J. Borst, coll.; Frecks, August 10, 1926, 3 adults; streams on hillside above Balsam swamp in Red House valley, August 13, 1926, 5 adults; Frecks, August 17, 1926, 5 adults, Ruth Wagner, coll.; Breeds run, August 18, 1926, 2 adults; Willis creek, August 20, 1926, many specimens along stream borders; Blacksnake mountain, August 20, 1926, 1 adult, W. P. Alexander, coll.; Frecks, August 21, 1926, 1 adult; upper end of Red House valley, August 25, 1926, 1 adult.

11 The Allegany Salamander; Mountain Salamander,

Desmognathus fuscus ochrophaeus (Cope)

The average-sized Mountain Salamander is about three inches long but occasionally individuals will be found that measure three and three-quarters inches. The color pattern is essentially constant where it can be made out at all, but the colors themselves are extremely variable. Old individuals may be almost entirely black above but the majority of specimens will be marked as follows: Along the middle of the back, a broad, light band bordered on each side by a dark band, which may be narrow or broad enough to cover the upper sides. When the dark bands are broad, the color fades on the lower sides to the pale belly; if narrow, the sides are grayish or brownish. Along the mid line of the back there is usually a narrow line of black dots. The tail is round and tapers to a sharp point but may be slightly flattened towards the tip. The belly is light and often slightly mottled and there is a light line running from the eye to the angle of the jaw as in *Desmognathus fuscus fuscus*. Young specimens may have the dorsal band reddish or yellowish, and resemble certain specimens of the Red-backed Salamander; but the lighter belly, larger hind legs and light line from the eye to the jaw of the Mountain Salamander will serve to distinguish them.

Habits. This salamander is found in a great variety of situations throughout the park. They abound under logs and stones in wet places, beneath the bark of fallen trees and in comparatively dry situations in leaf mold and humus. They are more terrestrial than the Dusky Salamander and may be found on the hilltops far away from open water. In the low grounds they often associate with the Dusky Salamander under logs and stones. They are active when disturbed and seek to escape by burrowing and running.

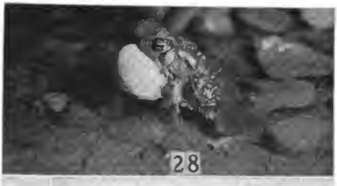
Very little is known of the egg-laying habits. A single lot of eggs, apparently of this species, was found August 2, 1924, near Troy, Pa. They were in a little excavation beneath a small board by the side of a spring.

Records. Mount Onondaga, August 10, 1926, 5 adults; hillside above Balsam swamp in Red House valley, August 13, 1926, 3 adults; Breeds run, August 18, 1926, 7 adults; Stony creek, August 19, 1926, 3 adults; Frecks, August 21, 1926, 2 adults; upper end of Red House creek, August 25, 1926, 1 adult.

12 American Toad, *Bufo americanus* (Holbrook)

Figures 28, 29

The common and widely distributed American Toad is found throughout the park. In this area where none of its near relatives has been reported, it is easily distin-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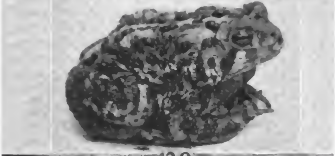
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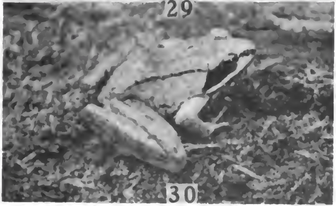
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Figure 28 American Toad, *Bufo americanus* Holbrook. Croaking male partly in water. Flashlight by A. H. Wright. **Figure 29** American Toad. Note warty skin, short stout legs and large glands back of head. Photograph by A. H. Wright. **Figure 30** Wood Frog, *Rana sylvatica* Le Conte. The black patch below and back of the eye is characteristic of this species

guished from all other amphibians. The short, stout limbs, warty skin and prominent kidney-shaped glands on the back of the head are characters that make it unmistakable.

Habits. The adult toads are chiefly nocturnal, although during the breeding season and in dark rainy weather they are often abroad during daylight hours. On bright days they secrete themselves under logs, stones or boards, in cellarways or the deep shade of rank weed patches. Often their hiding place becomes a retreat in which they make their headquarters through the summer.

Early in April the toads wake from their winter sleep, crawl out of the ground and shortly afterward start for the breeding ponds. It is only a little while after they first appear that their spring chorus is heard from every shallow pond, ditch and pool (figure 28). This is the season of egg laying. The eggs, to the number of four to eight thousand, are laid in long jellylike spiral tubes and are usually found tangled around water plants or sticks on the pond bottom. When freshly laid in clear water, the jelly is transparent and the individual eggs appear as small black beads; usually, however, the eggs are partly obscured by the fine silt or mud that clings to the jelly covering. The eggs are round when laid but soon begin to elongate and within a few days the young tadpoles are formed and hatch.

A newly hatched tadpole lives for a few days on the yolk with which it was supplied in the egg. During this short time there is no true mouth but in its place is a suckerlike V-shaped ridge which secretes a sticky substance. By means of this "sucker" the young tadpole holds itself right side up against a water plant, stone or other object.

When it is two or three days old, small external gills may be observed on each side of the throat. They remain for a few days, then disappear beneath a membrane which grows down over them. The gills are now internal instead of external and the water which passes over them enters through the mouth and nostrils and is forced out of a small opening or "breathing pore" on the left side of the throat.

The tadpole usually develops a mouth when it is a little over a week old and then starts feeding on its own account. As it develops, the tail grows longer and broader and serves as a swimming organ. In a month or a little longer the hind legs appear and about two weeks later the fore legs, the left one pushing out of the "breathing pore." The tail then begins to shorten by absorption and the tadpole may be observed to come to the surface more frequently to swallow air. At this period it is preparing for its life on land although it may be less than half an inch long.

During its life as a tadpole, its food has been largely composed of the minute plant life found on the stones, sticks or larger plants in water. When it becomes a fully developed toad its habits change and it feeds on insects, worms, slugs, spiders and other forms of animal life.

In the park, the tent platforms and steps or boards leading to them form ideal retreats for toads and during the summer months many make use of them.

Records. The toads are everywhere so common in the park that they may be found throughout the summer. A single half-grown specimen from Frecks, taken August 18, 1926, by Clarence Wagner, was preserved as a record.

13 Spring Peeper, *Hyla crucifer* (Wied.)

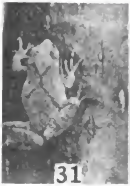
Figure 31

The Spring Peeper grows to a length of about one inch and is the smallest tailless amphibian in the park. It is variable in color, shading through brown, tan and yellow to greenish gray. The darker markings are more constant, and taken with the small size, distinguish it from any other species. On the back there is a dark oblique cross and usually between the eyes a dark V-shaped mark. The legs are marked with transverse bands and the tips of the toes are expanded into little disks.

It is common in the park but during the summer months, when it is usually silent, it is never conspicuous. It may be found, however, by searching the low wet places both on the ground and on low growing plants and trees.

Habits. This is the first frog to appear in the spring and its voice announces its arrival. In late March or early April every marsh and swamp, pool and ditch is resonant with its calls—clear, shrill, piping whistles, sometimes trilled. Egg laying begins about the time the frogs are in full chorus and may continue well into May. The eggs are deposited one at a time to the number of eight hundred or more and are attached singly to grass, leaves or other vegetation below the surface of the water. The eggs hatch in one to two weeks depending on the temperature of the water and the entire period from deposition to transformation is about three months. Transformation may begin the latter part of June and continue through July.

In the fall the peepers again may be heard from woods and swamps and hillsides but not in great choruses as



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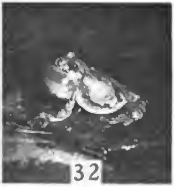

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Figure 31 Spring Peeper, *Hyla crucifer* Wied. Note the dark cross on the back. Photograph by C. R. Crosby, after A. H. Wright. Figure 32 Tree Toad, *Hyla versicolor versicolor* (Le Conte). Male croaking. Flashlight by A. A. Allen and A. H. Wright

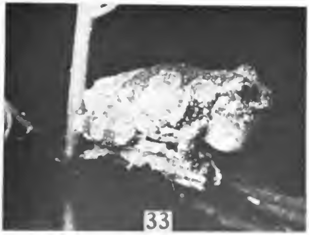

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Figure 33 Tree Toad, *Hyla versicolor versicolor* (Le Conte). Male with vocal pouch partially distended. Flashlight by A. H. Wright

in the spring. The food of adults consists largely of insects.

Records. Widely distributed in the park, particularly in the low wet places. Specimens were collected on Seneca mountain, August 10, 1921 by E. Green, and on the hillside above the Balsam swamp, Red House valley, August 13, 1926.

14 Tree Toad; Tree Frog; Rain Frog, *Hyla versicolor* (LeConte)

Figures 32, 33

The Tree Toad reaches a length of about two inches and has a rough warty skin and expanded toe tips. It has the ability to change its color to a considerable extent to match its surroundings so that the general ground color may vary from light ashy gray to brown or green. The darker markings, which are usually more constant, are disposed as follows: On the head above each eye there is a short, oblique, dark band; on the upper back a large irregular spot which is frequently star-shaped; on the lower back, on each side, a large oblique mark with irregular outline. The legs are transversely barred above while the under surface of the hind pair and the groin is bright orange yellow.

The Tree Toad is probably more widely distributed in the park than the records of specimens taken indicate. During the summer months many are silent for long periods and those heard calling are frequently in trees where it is impossible to see them. They also habitually hide among thick shrubs and vines and on fences and buildings.

Habits. Late in April or early in May the Tree Toad comes from hibernation and soon afterward seeks the breeding ponds. By the middle of May they are in full chorus and by the last of the month egg laying has begun in earnest and may continue through June.

The eggs are deposited at the surface of the water in little clusters among the leaves of aquatic plants and the total complement may number fifteen hundred or more. They hatch usually in less than a week and continue as larvae about two months. In late July they may begin to transform, the process continuing through the first half of August.

Records. Heard several times during August 1926 but no specimens collected. Reservation near Tunasassa, July 1921, 1 adult, W. P. Alexander, coll.

15 **Bullfrog**, *Rana catesbeiana* (Shaw)

Figure 34

Because there are no natural ponds within the park, the Bullfrog is largely confined to Tunungwant creek and its backwaters. With the completion of the dam across Quaker run a pond of several acres will be created and the Bullfrog may be successfully introduced or find its own way in.

The adult Bullfrog has a body length of six to eight inches and is our largest frog. The color is variable but is commonly green or greenish brown with darker markings on the back and sides. The legs are often barred or spotted with dark and the belly is light with dusky markings. In the male the throat is frequently yellow. The voice of the adult is a deep-toned sonorous bellow, heard most frequently on dark days or in the evening during June and July.

The full-grown frog is not easily confused with any other species. Young specimens may be distinguished from Green Frogs of the same size because the latter

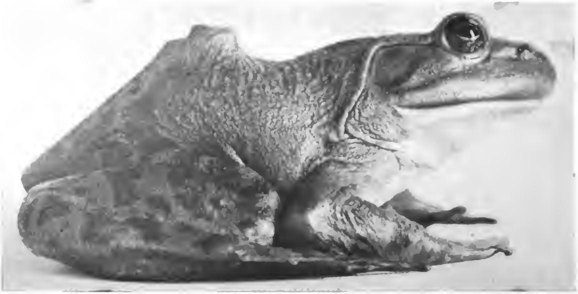


Figure 34 Bullfrog, *Rana catesbeiana* Shaw. Adult female about natural size. There is no fleshy ridge from eye to rump as in the Green Frog. The ear equals the eye in diameter in the female and is larger in the male. Photograph by A. H. Wright

have a fleshy ridge or fold on each side of the back from the eye to the rump.

Habits. The Bullfrog comes from hibernation about the middle of May or somewhat later if the season is backward, at a time when many of the other species have finished egg laying. The eggs are deposited the last of June or early in July in surface films that may cover an area two feet across and contain as many as ten to twenty thousand.

Development is rapid, the young tadpoles hatching in less than a week. In this species two years are spent as larvae, transformation coming in July or August when a length of about three and a half to four inches has been reached. The newly transformed frog is about half that length.

The adult frog is extremely voracious and will take almost any kind of animal food it can capture, even young water fowl. They are almost entirely aquatic and seldom leave the vicinity of permanent ponds or pools except when forced by the lowering of the water level.

Records. The Bullfrog has been reported from the Tunungwant valley and a large specimen from a pond there was collected July 10, 1921, by George Hume.

16 Green Frog, *Rana clamitans* (Latreille)

Figure 35

The Green Frog is common along water courses, in pools and springs and in the marshy lowlands throughout the park. In the larger permanent backwaters of the Tunungwant creek it is associated with its larger relative, the Bullfrog. The adults vary considerably in size, the females averaging larger than the males and sometimes reaching a length of about five inches. The color is also

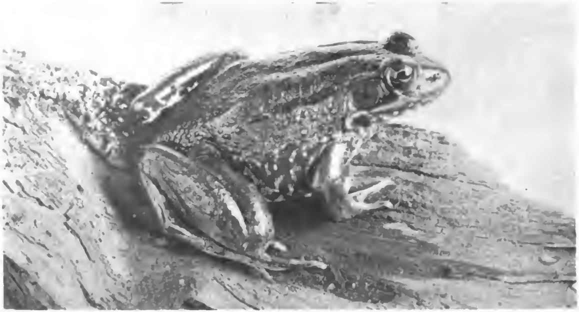


Figure 35 Green Frog, *Rana clamitans* Latreille. Adult female about natural size. Note the fleshy ridge from eye to rump. The round disk back of the eye is the "ear." In the male the ear is larger than the eye. Photograph by E. J. Stein

variable but usually the head and upper part of the back are bright metallic green and the lower back and sides darker and often spotted or barred. In the male the throat is bright yellow, in the female whitish with dark mottlings. On each side of the back from eye to rump there is a prominent ridge or fold which in the Bullfrog is lacking.

Habits. While the Green Frog is less dependent on large permanent pools and ponds than the Bullfrog, it is usually found in the water or near enough to reach it in one jump.

It may appear in the spring as early as the last week in March or delay its appearance until the middle of April. It is not usually heard until several weeks after it first emerges and the voice is a low-pitched croak or series of croaks.

The eggs are deposited in small packets which form surface films much like those of the Bullfrog, but the masses are smaller and seldom cover an area more than a foot in diameter. Egg deposition may start the middle of May but is usually later and the period may extend well into June. The eggs to the number of two to four thousand hatch in from three to six days, depending on temperature. The tadpole reaches maturity in about one year after the eggs are laid and at this time has a length of about three inches. The recently transformed frog is about half that length.

Records. Slide hollow, July 4, 1921, 1 adult, W. P. Alexander, coll.; Tunungwant valley, July 10, 1921, 1 adult, G. Hume, coll.; Freeks, August 1, 1922, 1 adult, W. P. Alexander, coll.; Cold Spring (Allegany Reservation) July 13, 1921, 1 adult, W. P. Alexander, coll.; Pickup's pond near Pine Hill, N. Y., August 28, 1926, several seen. In 1921 they were observed in the low wet places along the Allegheny and Quaker run from Headquarters to Quaker Indian School.

17 **Pickerel Frog,** *Rana palustris* (LeConte)

Figure 37

The Pickerel Frog is apparently much less common in the park than its relative, the Leopard Frog, and most of the specimens taken were found near the limits rather than in the park itself. It will doubtless be found rather widely distributed, however, when extensive collections have been made.

The full-grown frog reaches a length of about three inches. The general color is brown of various shades and there is a double row of large, squarish, dark spots on the back between the lateral folds. The sides are also spotted, an upper row of large spots bordering the lateral folds and a second row in which the spots are smaller, on the lower sides. The legs are strongly cross-barred. The under surfaces of the hind legs and the lower rear parts are bright orange.

Habits. During the breeding season the Pickerel Frog is found in cold brooks and springs, marshes and bogs. Later in the season it abandons the water and takes to the meadows, where most of the summer months are spent.

It appears in the spring during the latter part of March or the first half of April and usually begins to mate and deposit eggs during the latter part of April. The eggs are most frequently deposited in clear shallow water and are attached to submerged twigs, grass stems or other vegetation. The complement of some two to three thousand eggs is distributed in several large globular masses, three to four inches in diameter. The eggs hatch in from ten days to three weeks and the tadpoles usually reach full development toward the end of July or early in August

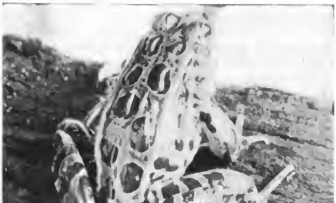


Figure 36 Leopard Frog, *Rana pipiens* Schreber. Note rounded, light-bordered spots between the fleshy folds. Figure 37 Pickerel Frog, *Rana palustris* Le Conte. The spots between the fleshy folds are squarish. Photographs by E. J. Stein

at a length of about three inches. The newly transformed individual is about one-third as long.

The food of the adults consists of insects and worms, snails, crustacea and other forms of small animal life.

Records. Tunungwant valley, 1922, several specimens, W. P. Alexander, coll.; Cold Spring Reservation, July 1921, several specimens, W. P. Alexander, coll.

18 Leopard Frog; Meadow Frog, *Rana pipiens* (Schreber)

Figure 36

The Leopard Frog is common in the park. During the summer months it is found in fields, meadows and grassy woods, and in spring and winter, in streams and swamps.

The adult female sometimes reaches a length of four inches but this is exceptional and the average size is nearer three and one-half inches. The males are smaller.

In the Leopard Frog the ground color is generally greenish but varies through shades of gray to brown. There are two irregular rows of rounded, light-bordered dark spots on the back between the lateral folds and two rows on each side below the lateral folds. The legs are strongly barred or spotted. The underparts are silvery white with sometimes tinges of yellow behind.

The only other frog in the park likely to be confused with it is the Pickerel Frog, which has bright orange on the lower surfaces of the hind legs and squarish spots on the back and sides.

Habits. Except during the breeding season this is preeminently the frog of open meadows, pastures and orchards. In winter it hides beneath stones and logs in springs and streams or buries itself in the mud of swamps. Late in March the first individuals appear, usually a day or two after the Spring Peeper, and within a week or ten days begin their croaking. Egg laying usually starts during the second week in April but the time varies considerably from year to year with differences in temperature.

The eggs are deposited in several plinthlike masses and are usually attached to submerged sticks, grass stems, cat-tails or bottom rubbish of various kinds. The mass when fully expanded may be four to six inches across and two or three inches thick and the several masses composing the complement of a single female contain from 3500 to 4500 eggs.

The eggs hatch in from two to three weeks depending on temperature of the water, and the larvae require an additional period of two months or longer to reach their full development and a length of about three inches. The recently transformed frog has a body length of about one inch.

Records. During July and August from 1921 to 1923, specimens were constantly brought to the field museum of the Buffalo Society of Natural Sciences maintained at the park. Quaker run, August 1921, 2 adults, W. P. Alexander, coll.; Pickup's pond near Pine Hill, N. Y., August 28, 1926, common along the edges of the pond.

19 **Wood Frog,** *Rana sylvatica* (LeConte)

(See Figure 30)

The Wood Frog is common in all the wooded area of the park, particularly in the deeply shaded ravines and along the watercourses. Even in the drier situations they are often found where the discovery of any other species would be unusual.

This is a relatively small species, the female reaching a length of about three inches and the male two to two and one-half inches. The ground color varies through shades of brown to tan and yellow with tan predominating in the majority of specimens. The sides and lower back are sometimes spotted and the legs cross-barred. On each side of the head back of the eyes there is an elongate dark brown or black spot which covers the ear region. In front of the eyes the dark is continued to the snout in a narrow bar.

Habits. This is more truly a land frog than any other species in the East. Except for the short breeding period in the spring when it enters the water, it is found in woods both in swampy situations and in the drier uplands. It appears from hibernation about the same time as the Spring Peeper or a few days later, usually the last of March or early in April, and makes at once for the breeding waters which may be woodland pools, backwaters of slow streams or open places in cat-tail marshes. Mating and egg laying begin at once and the procedure is accompanied by much gutteral croaking and clucking.

The eggs are deposited in globular masses two to four inches in diameter, attached to grass stems, twigs, branches or leaves in quiet waters, often where it is so shallow that many masses float at the surface. A single female deposits from two to three thousand eggs in several masses which hatch under normal conditions in from 11 to 27 days. Transformation requires an additional period of two to three months when the larvae have attained a length of nearly two inches. When fully transformed the body length of the young frog is about three-fourths of an inch.

Records. Throughout the period, 1921 to 1923, when the Buffalo Society of Natural Sciences maintained its field museum, the frogs were so abundant that they formed the chief food of about fifty captive garter snakes. Butler's run, August 5, 1926, 1 adult; Buffalo Camp, August 17, 1926, 1 adult, Clarence Wagner, coll.; Buffalo Camp, August 31, 1926, 1 adult.

ANNOTATED LIST OF THE REPTILES OF ALLEGANY STATE PARK

BY

SHERMAN C. BISHOP AND W. P. ALEXANDER

Introduction

During the summer months, 1921 to 1923, the Buffalo Society of Natural Sciences maintained a field museum at its camp in Allegany State Park and a Natural History Trail through the woods from the camp to the rock crevices locally known as the Bear cave. Both museum and trail were established by W. P. Alexander and were under his supervision, and both contributed largely to the summer life of campers and visitors in the park.

Many of the specimens here listed were collected for the camp museum exhibits and having served that purpose were preserved in the collection of the Buffalo Society. These records were supplemented by field notes, photographs and collections made throughout the years 1921 to 1925. In August 1926 intensive field work resulted in some interesting additions, most important of which was the discovery of a specimen of Butler's Garter Snake, *Thamnophis radix butleri* (Cope), the first recorded in the State.

Names of collectors are given except where specimens were taken by the writers.

1 **Ring-neck Snake,** *Diadophis punctatus edwardsii* (Merrem)

(See Figure 2)

The slender little Ring-neck Snake is fairly common in the park and may be collected by turning stones and logs both in the woods and open pastures.

The color above is dark gray or black. Back of the head is a yellow or white ring which involves about two rows of scales. The belly is orange yellow, usually plain but sometimes with a median row of small black spots. There are fifteen rows of smooth scales and from 140 to 160 ventral scales. This species attains an extreme length of nearly 20 inches. The largest specimen from the park measured 18 inches.

Habits. The Ring-neck Snake is a harmless, timid, secretive species that hides by day in the shelter of stones and logs or beneath the loose bark of stumps and fallen trees. Only one of the several specimens collected in the park was found in the open and this was crawling in the low herbage covering the top of a large block of conglomerate.

The young are normally hatched from eggs deposited beneath stones or logs. Ditmars (Reptile Book, p. 336) records that eggs deposited June 28th hatched August 8th, a period of incubation of only 41 days. We have no records of breeding habits of the species in the park.

The food consists of insects, worms, small salamanders, lizards and other snakes.

Records. Specimens were found on three successive days (August 5, 6, and 7, 1921) beneath the same flat stone by the side of Quaker run, F. Bowman, coll.; Red House valley, July 26, 1922, 1 14-inch specimen; Elko mountain, Allegany Indian Reservation, July 10, 1923, 1 13½-inch specimen; Quaker run, September 1925, 1 18-inch specimen, H. Marchand, coll.; Little Rock City (Allegany State Park) August 11, 1926, 1 small specimen; hillside above Balsam swamp in Red House valley, August 13, 1926, 1 small specimen found in a rotten log; Frecks, August 21, 1926, 1 adult.

2 Smooth Green Snake; Grass Snake, *Liopeltis vernalis* (Harlan)

Figure 38

The Green Snake resting quietly in green grass or foliage is so perfectly protected by its color that the number of individuals seen in a locality is probably not an accurate index to the number actually present. The brilliant grass-green color, smooth, satiny scales and slender form mark it as one of the most beautiful reptiles. The belly is light, pale greenish or yellowish white and the scales are in 15 rows.

Habits. The Green Snake often frequents boggy areas where it may be found in the low surface cover or climbing in shrubs or the branches of trees. It is not restricted to such situations, however, for it is sometimes found in grassy meadows that are quite dry or in open woods. The young are hatched from eggs which are about one inch long and a third of an inch in diameter when deposited (figure 39). They commonly number from six to a dozen and are laid under logs, stones or old planks. The eggs have been found in the park on several occasions. On August 11, 1922, a clutch of six was discovered beneath a flat stone beside Coon creek road. On August 12, 1923, seven eggs were found under an old plank on the site of Jaeger Mill. A small specimen taken at Camp Turner on August 21, 1926, deposited two eggs on the day of capture and four others on September 2, 1926.

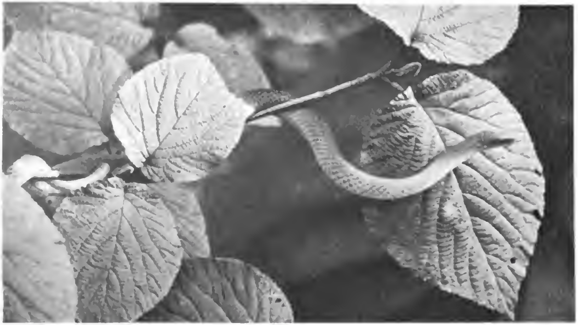


Figure 38 Smooth Green Snake, *Liopeltis vernalis* (Harlan). This species frequents boggy areas, meadows and open woods and is sometimes found among the branches of low shrubs

The Green Snake reaches a length of about 21 inches and in a specimen of this size (actually 20¾ inches) the tail measured 7½ inches. The average-sized specimen is smaller, perhaps nearer 15 to 18 inches in length. The food of the Green Snake consists largely of insects, spiders, caterpillars and other small forms of animal life.

Records. Buffalo Camp, July 3, 1921, 1 adult, 14 inches long; Coon creek, July 30, 1922, 1 adult, 12½ inches long, J. Borst, coll.; Coon creek road, August 11, 1922, 1 lot of 6 eggs under a flat stone; Upper end Wolf run, August 15, 1922, 1 adult, C. C. Adams and W. P. Alexander, coll.; Jaeger Mill, site of, August 12, 1923, 7 eggs beneath a plank; Coon creek, August 12, 1924, 1 adult; Camp Turner, August 21, 1926, 2 adults.

3 Pilot Blacksnake, *Elaphe obsoleta obsoleta* (Say)

The Pilot Blacksnake is apparently rare in the park area, only a single specimen having been collected. This fine snake, 58 inches long, was taken August 13, 1922, on Parker mountain by W. P. Alexander.

The Pilot Blacksnake is the largest species in the East, individuals 8 feet long having been reported. The color above is a lustrous black in typically marked individuals but on some there is a quite definite pattern of large blotches. The chin and throat are white, the belly blotched gray and white or almost uniform gray. The scales are in 25 to 27 rows, those on the back being slightly keeled. The only snake with which it is likely to be confused is the common Blacksnake, which has not as yet been reported in the park.

Habits. This snake frequents rocky bush-grown ledges where on bright days it may sometimes be seen sunning itself on bushes or rocks. It is a strong agile species, capable of traveling very rapidly over rough ground and of defending itself vigorously. The bite is,

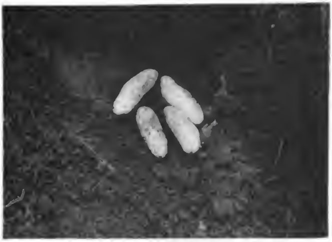


Figure 39 Eggs of the Smooth Green Snake, *Liopeltis vernalis* (Harlan). Photograph from the Buffalo Society of Natural Sciences

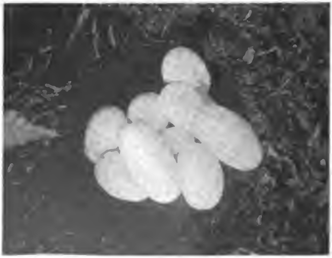


Figure 40 Eggs of the Milk Snake. *Lampropeltis triangulum triangulum* (Lacépède). The eggs are usually stuck together; they have been somewhat separated to show the number and shape. Photograph from the Buffalo Society of Natural Sciences

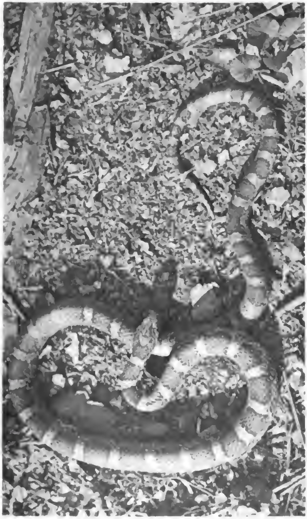


Figure 41 Milk Snake, *Lampropeltis triangulum triangulum* (Lacépède). The color pattern and smooth scales are distinctive. About one-third natural size

of course, not venomous. The young are hatched from eggs, which may be two inches long and nearly an inch in diameter. Ditmars (Reptile Book, p. 306) records that a specimen in captivity deposited 10 eggs on the 26th of June.

Records. Parker mountain, August 13, 1922, 1 adult 58 inches long.

4 Milk Snake; Spotted Adder, *Lampropeltis triangulum triangulum* (Lacépède)

Figure 41

The Milk Snake is common in the park and because it is conspicuously marked and often hunts during the day, many specimens are killed or captured. The pattern of a typically marked specimen is essentially as follows: There is a dorsal series of large chestnut or grayish blotches narrowly bordered with black and separated by light gray interspaces (figure 44). A lateral series of smaller but similar blotches usually alternates with those of the dorsal series. The belly is irregularly checkered with squarish black and white blotches (figure 45). The scales are smooth and in 21 rows. The snake reaches a length of about one yard and is fairly slender and graceful.

Habits. We have found the Milk Snake in numbers in open woods and pastures, in the vicinity of old buildings where it hunts for mice and in the meadows rank with weeds and grasses. The species is oviparous. The eggs number six to a dozen and are about an inch long and half an inch in diameter (figure 40). They frequently adhere, forming rather compact masses, and are deposited, usually in July, beneath logs, stones or boards. The young hatch after a period of incubation of about two months. The food consists chiefly of small rodents, mice and young rats, etc., as well as snakes and small lizards.

Records. Frecks, July 3, 1921, 1 adult 30 inches long; English run, July 26, 1921, 1 adult 29 inches long, F. Bowman & C. Snyder, coll.; Slide hollow, July 16, 1922, 1 small specimen 17½ inches long; Three Sisters mountain, July 30, 1922, 2 specimens 26 and 28 inches long, respectively; Jaeger Mill (site of) August 9, 1923, clutch of eggs beneath an old plank; Coon creek, August 11, 1923. A clutch of eggs supposed to be of this species found exposed on the top of a large block of conglomerate; Quaker Bridge, August 12, 1923, a 32-inch specimen brought to the camp museum by an Indian; Dry run, August 15, 1923, 1 small specimen 19¼ inches long. During August 1926 several specimens taken in the park were on exhibition in the cages of the outdoor museum of E. Countryman. These were later presented to the State Museum. Blacksnake mountain, August 17, 1926, a large specimen 39 inches long found dead in the woods.

5 **Water Snake,** *Natrix sipedon sipedon* (Linné)

Figure 46

The Water Snake is common along the open waterways, in reedy marshes, and in the boggy areas bordering streams in the low grounds. Here on warm days they may often be found sunning themselves on brush or stone piles or hunting frogs and fish in the water itself. Exceptionally large individuals may measure four feet in length but the average adult is nearer three feet. The body is stout and the tail short and abruptly tapering. The Water Snake is usually bad tempered, difficult to tame and disagreeable to handle because of the vile-smelling secretion of anal glands. The color pattern is conspicuous in young individuals but fades as the snake grows older and becomes almost obscure in old specimens. Where the pattern is well developed there is, on the forward part of the body, a series of dark brown cross bands separated by narrow interspaces. The cross bands taper

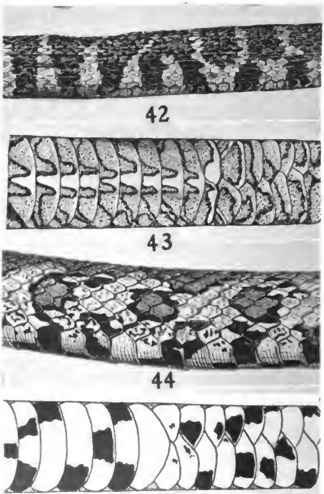


Figure 42 Water Snake, *Natrix sipedon sipedon* (Linné). Side view to show color pattern and keeled scales. Figure 43 Belly view to show pattern and ventral plates. Figure 44 Milk Snake, *Lampropeltis triangulum triangulum* (Lacépède). Side view to show color pattern and smooth scales. Figure 45 Belly view to show pattern and ventral plates. Drawings by E. J. Stein and W. J. Schoonmaker

on the sides where the interspaces are correspondingly wider (figure 42). On the hind part of the body there is a dorsal series of broad dark blotches and on each side a second series of smaller spots alternating with those above. The belly is blotched and mottled with black-edged crescent-shaped gray or reddish spots on a lighter ground color (figure 43). The scales are keeled and usually in 23 rows.

Habits. The Water Snake frequently rests on branches or logs overhanging the water, into which it throws itself when disturbed. Often they are discovered in the bed of a stream when stones or logs are turned in shallow water. They are carnivorous and voracious, the food consisting chiefly of fish and frogs. The young are born alive, about two dozen comprising the average complement.

Records. Quaker run, July 14, 1921, 1 small specimen 13⅜ inches long; Swimming hole at Frecks, July 6, 1921, 1 specimen 25⅛ inches long; Quaker run near Headquarters, August 11, 1921, 1 adult 36 inches long; Buffalo Camp, August 14, 1921, 1 adult 32 inches long; near Quaker school, July 17, 1922, 1 adult female, 30 inches long. On September 11, 1922, this female gave birth to 25 young. A female 29 inches long, taken on the Indian Reservation by Jasper Watts, July 30, 1922, gave birth to 20 young on August 30, 1922; Quaker run, August 23, 1926, 1 young 21¼ inches long; Tunasassa, August 19, 1926, a specimen 33 inches long, found coiled in an open field near the river. During August 1926 four large specimens taken in the vicinity of Headquarters were on exhibition in cages at the store of E. Countryman.

6 DeKay's Snake; Brown Snake, *Storeria dekayi* (Holbrook)

Figure 47

DeKay's Snake is one of the smallest species found in the park, full-grown individuals rarely reaching a length of 15 inches and the majority of specimens con-

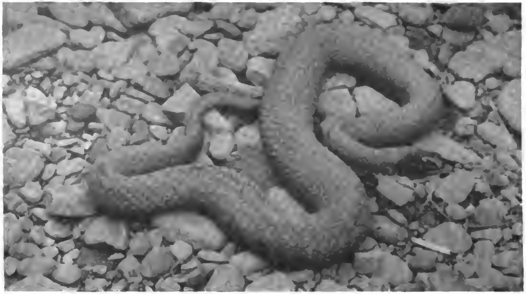


Figure 46 Water Snake, *Natrix sipedon sipedon* (Linné). An old dark specimen in which the color pattern is mostly lost. About one-third natural size

siderably smaller. It is much less common than its relative the Red-bellied Snake with which it is sometimes associated. The general color of the dorsal surface varies from grayish to chestnut brown and along the mid line of the back there is a clay-colored band bordered on either side by a series of black dots. The belly is whitish or pinkish with some gray encroaching on the ends of the ventral plates. The keeled scales are in 17 rows.

Habits. This is a secretive species usually found hiding beneath stones or logs in fairly dry situations. It is timid and inoffensive and feeds largely on insects, slugs and earthworms. The young to the number of a dozen or so are born in late July or in August.

Records. Coon creek, July 20, 1921, 1 small specimen 7 inches long; Mount Mohawk, August 1, 1921, 1 adult 10½ inches long; Mount Onondaga. August 2, 1921, 1 adult 9 inches long; Buffalo Camp, July 30, 1922, 1 adult 10 inches long.

7 Red-bellied Snake, *Storeria occipito-maculata* (Storer)

Figure 48

The Red-bellied Snake is found in considerable numbers throughout the park usually beneath logs or stones in woods or, more rarely, in similar situations in open pastures and fields.

The general color above is grayish brown. In many individuals there is a lighter median stripe which is bordered on each side by a narrow line of small dark brown or black dots. Back of the head there are three light yellow or dull white spots sometimes separate but often fused. On the lower sides there is a light gray band and bordering this below and extending onto the ends of the ventral plates is a darker band, slate gray. The belly is bright red. The scales are rather strongly

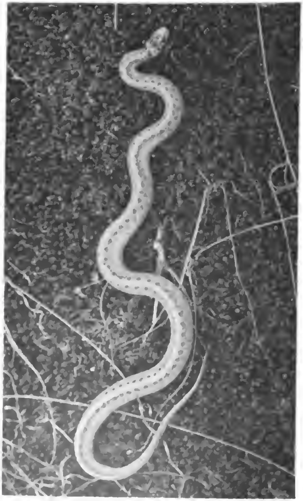


Figure 47 De Kay's Snake, *Storeria dekayi* (Holbrook). The dorsal stripe is clay-color in life and bordered by a series of dark dots. About one-half natural size

keeled and in 15 rows. This snake and *Storeria dekayi* grow to about the same size, mature specimens of the Red-bellied taken in the park averaging about 11 inches in length.

Habits. This is a ground-loving species that forages for insects, slugs and worms beneath logs and stones or among the débris of the forest floor. It is viviparous and brings forth its young, from six to a dozen or so, in the latter part of August or early in September (figure 49). On July 9, 1921, a pair in coitu was found in a clump of Taxus in the woods near Buffalo Camp. Dissection of the female, which was preserved at the time of capture, showed well developed embryos.

Records. A female 9½ inches long taken in the park on June 29, 1921, produced six young on August 28, 1921, C. Snyder, coll.; Buffalo Camp, July 4, 1921, 1 adult 10 inches in length; Creekside trail, July 4, 1921, 1 adult 12½ inches long; Buffalo Camp, July 9, 1921, 1 male 11 inches long, 1 female 13 inches long (in coitu), L. Eggleston, coll.; Frecks, July 14, 1922, 1 adult 12⅝ inches long; Stony creek, August 7, 1922, 1 adult 11¾ inches long; Ranger trail, August 8, 1922, 1 adult 10⅝ inches long; Mount Onondaga, July 14, 1923, 1 young 8⅝ inches long; Frecks, August 22, 1926, 1 female 12½ inches long, distended with embryos. On dissecting this specimen 9 embryos were found which varied in length from 3¼ to 3 11/16 inches in length; Camp Turner, August 24, 1926, 2 adults, one of which, a female 10⅝ inches long, gave birth to 9 young September 5, 1926. The young varied in length from 3 3/16 to 3 11/16 inches. Buffalo Camp, August 31, 1926, 1 adult 11⅜ inches long.

8 **Butler's Garter Snake,** *Thamnophis radix butleri* (Cope)

The single specimen of this interesting snake, found in the valley of Tunungwant creek near Limestone, N. Y., is the first record of the species for the State. Tunungwant creek is a tributary of the Allegheny and therefore of the Ohio system. The nearest localities at which the species has been taken are Port Allegany and Franklin,

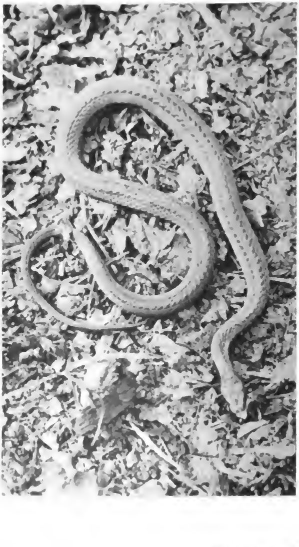


Figure 48 Red-bellied Snake, *Storeria occipito-maculata* (Storer). Adult specimen about natural size. In life the belly is bright red and there are three light spots back of the head

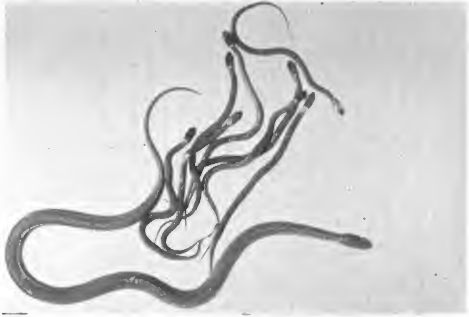


Figure 49 Red-bellied Snake, *Storeria occipito-maculata* (Storer) and her young. The photograph shows the shrunken condition of the female after the birth of the young. Note light spots back of the head, quite conspicuous in young. Photograph by E. J. Stein

Pa., also on the Allegheny. Thus the specimens which mark the eastern limits of the range of the species were all taken in the Ohio drainage but just outside the glaciated areas of southwestern New York and northwestern Pennsylvania. Most, if not all, of the other specimens of the species have been taken within the glaciated areas.

Butler's Garter Snake reaches only a moderate size, the average length of adults being about 18 inches. A distinctive feature is the small and narrow head which immediately distinguishes it from the common Garter Snake. The ground color above is uniform dark brown, marked along the mid line of the back with a yellow line which fades or becomes duller towards the tail. The lateral bands anteriorly encroach on the fourth row of scales but farther back are confined to the second and third rows. The keeled scales are usually in 19-17 rows, sometimes 17-19-17 or 17-17-17 as in the Limestone specimen. There is also a tendency toward a reduction in the number of head plates, the upper labial plates numbering only six or seven and the lower labials usually seven or eight.

The only species in the park with which Butler's Garter Snake is likely to be confused, is the common Garter Snake which grows to a much larger size, has a greater number of scale rows and usually has a decidedly checkered pattern between the light stripes. The Ribbon Snake, which also occurs in the park, has the lateral stripes on the third and fourth rows of scales but the body is extremely long and slender and the scales are in nineteen rows.

Habits. In common with the other Garter Snakes, this species is viviparous. Ditmars (Reptile Book, p. 224) records the birth of 12 young on August 4th. The habits of the species, so far as the published records reveal them, indicate a preference for low, wet situations in the vicinity of streams, and in just such a situation the specimen from Limestone was taken.

Records. Tunungwant valley near Limestone, N. Y., August 22, 1926, 1 specimen 14¼ inches long.

9 Ribbon Snake, *Thamnophis sauritus* (Linné)

While a number of specimens of the Ribbon Snake have been collected in the park, this species is apparently less common than the Garter Snake which it somewhat resembles. The former is much more slender, however, and the light stripes of the back and sides are more conspicuous. Furthermore, the square blackish blotches which are usually well developed between the stripes of the Garter Snake are absent or only faintly indicated in the Ribbon Snake. The ground color of the Ribbon Snake varies from chocolate brown to black and the light stripes of the sides are on the third and fourth rows of scales. Below these lateral stripes there is a narrow band of lighter brown. The belly is unspotted, yellowish or greenish white and the keeled scales are in 19 rows. Large specimens may reach a length of almost a yard but the average is considerably less.

Habits. The Ribbon Snake frequents the meadows bordering streams and open pools of water where it hunts for insects, frogs, toads and tadpoles. It is not restricted to these situations, for we have found it in open woods, on dry hillsides and even at the summits of the higher mountains in the park. The species is viviparous and may produce as many as a dozen young, a number considerably below the average complement of the common Garter Snake. A 26-inch female taken

August 6, 1922, gave birth to nine young August 19, 1922, in the camp museum of the Buffalo Society of Natural Sciences. This individual lived until the summer of 1924 in the cages of the Buffalo Society and fed freely on earthworms.

Records. Mount Seneca (summit) July 9, 1921, 1 adult 25 inches long; English run near Headquarters, August 15, 1921, 1 adult 23¼ inches long, W. A. Dence, coll.; Fancher Camp, August 6, 1922, 1 female 26 inches long.

10 **Garter Snake,** *Thamnophis sirtalis sirtalis* (Linné)

Figure 50

The Garter Snake is found almost everywhere in the park from the wet low grounds to the summits of the drier hills. They are perhaps most abundant in grassy meadows bordering streams where they hunt for frogs and toads; but they also occur on the scrubby hillsides and in the open woods.

The majority of specimens taken are of moderate size but occasional individuals reach a length of about a yard and are stout-bodied in proportion. The ground color is extremely variable, even in a series from a comparatively limited area. It may vary from brown through shades of olive green to almost black. The stripes of the sides are on the second and third rows of scales and the dorsal stripe occupies the median row and parts of the adjacent rows. The sides between the lateral and dorsal stripes are marked with a double row of dark square spots, conspicuous in light-colored individuals but less evident in those having a dark ground color. The keeled scales are in 19 rows or 19-17 if the second count is made towards the tail.

Habits. In the early spring Garter Snakes, recently out from their hibernating quarters, like to bask in sunny open places where they often lie quietly for long periods.

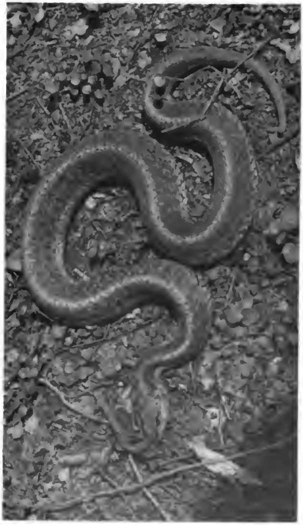


Figure 30 Common Garter Snake, *Thamnophis sirtalis sirtalis* (Linne). A large female photographed in a sunny open place in the woods. Actual length 34 inches; tip of tail lost

Later in the summer they disperse widely and are likely to be found almost any place where there is food and shelter. They are perhaps most frequently encountered along streams or the edges of little ponds where there is an abundance of food—frogs, toads, salamanders or earthworms.

We have not observed the mating habits of this species in Allegany State Park, but in John Boyd Thacher Park, Albany county, some observations were made by E. J. Stein and H. H. Cleaves, which are of interest. On May 2, 1926, while crossing a wooded terrace on the Helderberg escarpment several Garter Snakes were noticed moving restlessly about on the ground. A more careful search revealed the presence of another individual, which subsequently proved to be a female, stretched out on the low branch of a small hemlock. While this individual was under observation, two of the snakes on the ground made their way to the tree and climbing out on the branch attempted to place themselves in contact with her. The struggles of the competing males caused all three to tumble to the ground. The female again climbed into the hemlock and was followed by the two males which covered her track exactly as a dog follows the scent of a rabbit. The first male to reach the female measured his length on her body following all its curves with the chin pressed to her back. Mating followed with the second male attempting so persistently to join the pair that all three again fell to the ground. The mated pair, maintaining their position, crawled off beneath loose leaves on the ground, the second male in the meantime having disappeared.

The young are usually born in August or September and the number produced may be anywhere from a dozen to seventy or more.

In the late fall the snakes seek hibernating places and are rarely seen until spring. On one or two occasions, however, we have found them in midwinter beneath large flat stones under water in the bed of a spring.

Records. Jaeger Mill (site of) July 18, 1921, 1 adult 21⅛ inches long; Quaker run, upper end, August 1, 1921, 1 female 27 inches long, produced 32 young August 17, 1921; Mount Cayuga (foot of) August 1, 1921, 1 adult 21¼ inches long; near Frecks, July 29, 1922, 1 female 29 inches long, produced 27 young August 22, 1922, F. Bowman, coll.; Coon creek road, August 3, 1922, 1 adult 19⅜ inches long, J. Borst, coll.; Allegany Reservation near State Park, August 10, 1922, 1 vividly striped specimen 32 inches long, Glen Pierce, coll.; near Frecks, August 1923, 1 female 24 inches long and with stripes very obscure, gave birth to 17 young, all plainly marked; Frecks, August 17, 1923, 1 adult 27 inches long, most of tail lost; Woods near bridge over Quaker run at entrance of park, August 15, 1926, 1 adult 26¼ inches long; Blacksnake mountain, August 17, 1926, 34-inch female. On September 20, 1926, this female produced about 45 young in the State Museum cages; Blacksnake mountain, August 17, 1926, 1 young 4⅝ inches long under a log; Stony creek, August 19, 1926, 1 specimen seen; Frecks, August 24, 1926, 2 specimens 20½ and 19¼ inches long. During August 1926, three Garter Snakes measuring respectively 19, 20 and 21 inches in length, were on exhibit in cages at the store of E. Countryman, near Headquarters.

11 Timber Rattlesnake; Banded Rattlesnake, *Crotalus horridus* (Linné)

The Timber Rattlesnake has never been found in any section of the park set aside for the use of campers and tourists. It appears to be restricted to certain small areas near the southwestern limits of the park and to a number of localities in the hilly parts of the Allegany Reservation. It is therefore not likely to be encountered and can not be regarded as a source of danger to those visiting the region.

This snake grows to a length of about five feet but the average-sized adult is nearer three and one-half or four feet. There is considerable variation in both color and pattern. The majority of specimens, however, are either yellowish with darker markings and cross-bands or dark brown with the cross-bands and spots less distinct. Between these extreme color phases there are various intergrades. In the park area and nearby localities all specimens taken have been of the darker phase. In this the ground color is dark brown. On the fore part of the body there is a dorsal series of large black blotches margined with dull yellow or light brown and a series of smaller but similar blotches on each side more or less connected with those above. On the hind part of the body the blotches of the back and sides are united to form definite cross-bands. Sometimes there is a lighter median dorsal stripe which breaks the large blotches into pairs.

The species is at once distinguished from all other snakes in the park by the rattle. Contrary to general belief, the age of the snake can not be determined by counting the number of segments in the rattle, for they are added one at a time when the skin is shed, a process which may take place two, three or even four times a year. Furthermore, the terminal segments are often worn or shaken off.

Habits. The Timber Rattlesnake frequents the rocky ledges and rough wooded hillsides. Here they are often seen sunning themselves on the bare rocks or may be found by turning the loose logs, stones and flakes of rock on the surface of the ground. During a very dry season they sometimes migrate to the lower grounds and may be numerous in open fields and meadows.

The species is viviparous and six to a dozen or more young ones may be produced in one litter. We have no notes on the breeding habits of specimens collected in the park, but a large yellow female taken near Honeoye Lake, N. Y., on August 19, 1925, gave birth to 13 young on October 4, 1925.

The food of the Timber Rattlesnake consists largely of small mammals such as mice, rats, squirrels and rabbits. Birds are also taken when they can be captured, and in captivity both birds and mammals are sometimes eaten.

Records. Brown's run, July 7, 1921, 1 small specimen 27 inches long; Sunfish run on Allegany Indian Reservation, July 7, 1922, the cast skin of a 27-inch specimen; Sunfish run, Allegany Reservation, July 14, 1922, 1 four-foot specimen taken in an open field above the Erie R. R. tracks; Peters run, July 15, 1922, 1 adult 42 inches long, A. E. Hubbard and W. P. Alexander, coll.; Elko mountain, August 17, 1922, 1 adult 47 inches long; Limestone hollow, August 17, 1922, 1 30-inch specimen; Limestone hollow, August 17, 1923, 1 adult 50 inches long; Peters run, August 30, 1923, 1 small specimen 28 inches long; Elko mountain, July 23, 1926, 1 specimen 32 inches long, H. D. House, R. Ruedemann, A. K. Lobeck and W. P. Alexander, coll.; Limestone hollow, August 6, 1926, 1 adult 58 inches long, H. D. House, A. K. Lobeck and W. P. Alexander, coll.

12 **Musk Turtle; Stinkpot,** *Sternotherus odoratus* (Latreille)

Figure 51

The little Musk Turtle has been collected but once in the park but it is undoubtedly common in the ponds and backwaters of the Tunungwant valley, in the creek itself and in other streams with muddy bottoms. Because of its small size, dull color and secretive habits, it is seldom conspicuous and often escapes attention when it is really quite abundant. Often, too, the upper shell is covered with a growth of algae that effectively conceals it when the turtle is resting at the surface among green plants.

The Musk Turtle seldom grows to a length of five inches and the majority of specimens are smaller. The carapace is strongly arched and quite narrow, the belly shell or plastron small and roughly cross-shaped. The general color is dull brown with or without darker markings. On each side of the head there are two narrow lines of yellow (one above and one below the eye) extending to the neck. The lower jaw is also marked with yellow in two narrow lines diverging backward.

Habits. This species is almost entirely aquatic, leaving the water voluntarily only for the purpose of depositing its eggs. The food consists of small animals — worms, fish, insects—and animal refuse of various kinds, this species being more or less of a scavenger. They are bottom foragers and spend much of their time in the muddy and weedy beds of slow streams and ponds. In shallow water they sometimes congregate in numbers to bask in the sun, particularly in the spring soon after release from hibernation.

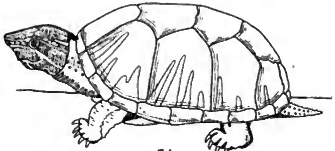
The eggs are smooth, white and elliptical, about one inch long and half as thick. Specimens in confinement from eastern New York deposited eggs on June 19th and June 23d. The female taken in Allegany State Park on July 10th deposited five eggs on July 19, 1921. In the field the eggs are laid in the soft wood of rotting logs or stumps, in the débris of muskrat houses and similar masses of rushes and reeds, and in soft yielding soil near ponds and streams.

Records. Tunungwant valley, July 10, 1921, 1 female, George Hume, coll.

13 **Snapping Turtle,** *Chelydra serpentina* (Linné)

Figure 54

Except during the egg-laying season the Snapping Turtle seldom leaves the water. It is most at home in ponds and marshes, slow muddy streams and stagnant



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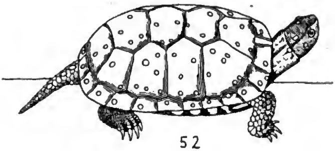

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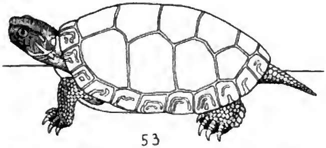

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Figure 51 Musk Turtle, *Sternotherus odoratus* (Latreille).

Figure 52 Spotted Turtle, *Clemmys guttata* (Schneider).

Figure 53 Western Painted Turtle, *Chrysemys bellii marginata* (Agassiz). Drawn by W. J. Schoonmaker

pools. Suitable situations in the Allegany State Park are almost entirely limited to the Tunungwant valley and it is here that specimens have been taken.

This is the largest species of freshwater turtle in the Northeast and individuals having a shell length of 14 inches and a weight of 40 pounds or more are sometimes collected. The average adult, however, is considerably smaller. The color above is dull, dark brown or black and the shell often supports a growth of algae that makes the animal inconspicuous when resting on the bottom of a pond or among green plants. The belly shell or plastron is roughly cross-shaped and so small that the soft parts are largely exposed. The color of the lower surfaces is dull yellow or dirty white.

Habits. The Snapping Turtle is a vicious species and largely carnivorous, eating almost anything of an animal nature it can capture. Fish, small mammals, various reptiles and amphibians and birds are taken, as well as smaller forms such as insects, snails and crawfish. The egg-laying habits have not been observed in the park but specimens in eastern New York were found June 22d preparing to lay their eggs in an open field 50 feet from water. That many turtles had already deposited their eggs before this date was evidenced by the great number of empty shells scattered over the ground, perhaps destroyed by skunks or crows.

The eggs are spherical, white, about one inch in diameter and provided with a thin hard shell. Twenty to thirty may be deposited by a single female in a shallow "nest" dug in soil or sand.

Records. Tunungwant valley, July 10, 1921, 2 small specimens George Hume, coll.

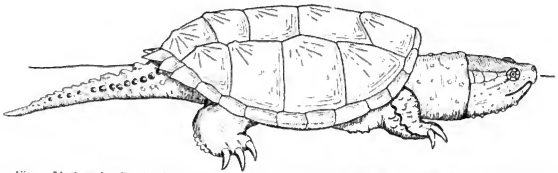

Figure 54 Snapping Turtle, *Chelydra serpentina* (Linné). The large head and long tail are characteristic. The hind margin of the upper shell is deeply notched. Drawn by W. J. Schoonmaker

14 **Spotted Turtle,** *Clemmys guttata* (Schneider)

(See Figure 52)

The Spotted Turtle is commonly found in ponds and reservoirs, woodland pools or swamps, or along the streams and open waterways in marshes and bogs. In some parts of its range it is exceedingly common but in the Allegany State Park only a single specimen has been taken.

The species reaches only a moderate size, adult specimens having a shell length of about four inches. The color above is black with numerous small, round, yellow or orange spots scattered over the shell, the upper surfaces of the legs and the top of the head. On each side of the head in the ear region and extending onto the neck is an elongate bright orange patch. The plastron is largely black with a lighter central area of irregular pattern and a few lighter marks along the marginal plates.

Habits. The Spotted Turtle spends much of its time either in the water or in close proximity to it. Often it may be seen on logs or stools of sedges basking in the sun, but the slightest disturbance sends it tumbling into the stream or pond. It is quite omnivorous in its feeding habits and will take insects, snails, spiders, small crawfish and worms as well as vegetable matter of various kinds. Babcock (Turtles of New England, p. 398) says that the time of egg laying in New England is practically that of the common eastern Painted Turtle, *Chrysemys picta*, that is, from the 10th to the 25th of June. The eggs commonly number two or three, more rarely four to the clutch. They are elliptical and average a little over an inch in length and two-thirds of an inch in diameter. Eggs of this species which were buried in sand June 16th hatched

September 6th, a period of incubation of 82 days (Babcock, p. 398).

Records. Tunungwant valley, August 1, 1921, 1 ♀ George Hume, coll.

15 Wood Turtle, *Clemmys insculpta* (LeConte)

Figures 55 and 56

During the summer months the Wood Turtle is likely to be encountered in woods or meadows almost anywhere in the park. It is thus much more terrestrial in its habits than the other species of turtles found here and more easily collected.

The adult turtle reaches an extreme length of about eight inches but the average is perhaps nearer six. The upper shell is dull brown and roughly sculptured with raised concentric lines on the plates. The belly shell or plastron is large, comparatively smooth, and yellow with a large black spot on the outer margin of each plate (figure 56). The skin, except on the exposed parts of the legs and head, is bright brick red.

Habits. Except during periods of extreme drouth the Wood Turtle spends most of the summer months wandering in woods and meadows. In very dry seasons it apparently seeks the streams and pools from time to time to replenish its water supply, for we have sometimes taken it on hook and line while fishing. In early spring and late fall it is more frequently found in water than in terrestrial situations. The winter is spent in hibernation in the mud of stream bottoms or more rarely on land in the woods.

In its feeding habits the Wood Turtle is almost omnivorous but shows a preference for vegetable foods, berries of various kinds, mushrooms, leaves, grasses and

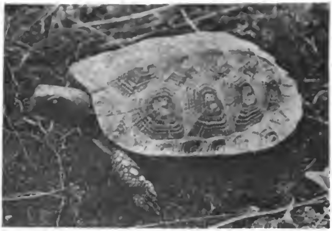

Figure 55 Wood Turtle, *Clemmys insculpta* (LeConte). Note the strongly sculptured plates

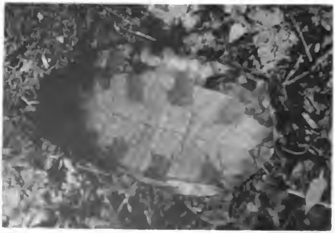

Figure 56 Wood Turtle, *Clemmys insculpta* (LeConte). Belly view to show the plastron and color pattern

seeds. It also takes insects and their larvae, earthworms, crawfish, snails and other fleshy foods when available.

The eggs are usually deposited in June in shallow excavations dug by the female. Individual eggs are elliptical, about one and one-half inches long and seven-eighths of an inch in diameter. Eleven eggs of large size were found in a female taken in December. The Wood Turtle is protected by law in New York State and should not be molested.

Records. Coon creek, July 20, 1921, 1 adult; Seneca mountain, August 15, 1921, 1 adult; Stony creek, August 2, 1922, 1 adult; Parker mountain, August 13, 1922, 1 adult; Reservation near Tunasassa, August 16, 1922, 1 adult; Reservation near park limits, September 1924, 1 adult, J Savage, coll.; Willis creek, August 29, 1926, 1 adult ♀.

16 **Western Painted Turtle,** *Chrysemys bellii marginata* (Agassiz)

(See Figure 53)

The Western Painted Turtle is the commonest pond turtle in the park area. It is most at home in ponds and slow streams but where these are lacking will often take up its residence in the quiet reaches of more rapid creeks and rivers. In the park it is most abundant in the valley of the Tunungwant, where the stream and its numerous shallow backwaters offer ideal conditions.

Large specimens reach a length of about six inches but this is exceptional, the average being about four and one-half to five inches. The shell is comparatively flat and smooth, dark brown, olive or black in ground color but marked on the marginal plates with crescentic patches and spots of crimson. The large plates of the carapace, or upper shell, are in three rows, those of the middle series alternating with the lateral. The plastron is yellow with a dark central patch covering portions of the paired plates. The head is dark, striped below with yellow and on the sides and back with paired lines and blotches. The neck and legs are striped with red.

Habits. The Painted Turtle is most frequently observed while it is basking on logs or tussocks of grasses and sedges. On bright days every suitable support will have its full quota of sprawling forms, ready at the slightest disturbance to tumble back into the water. The species is omnivorous, taking vegetation of various kinds in addition to insects, snails, mussels, fragments of fish and tadpoles, etc.

The smooth, pinkish white, elliptical eggs are laid in early summer, a specimen in captivity depositing five which had an average length of about an inch and a quarter and a diameter of about three-quarters of an inch.

Records. Tunungwant valley, July 10, 1921, 1 small ♀, George Hume, coll.; Peters run, August 14, 1923, 1 adult; Quaker run, August 6, 1926, 1 adult, J. Hofmayr, coll.

FIELD TRIPS FOR AMPHIBIANS AND REPTILES IN ALLEGANY STATE PARK

BY

SHERMAN C. BISHOP AND W. P. ALEXANDER

A number of field trips to various parts of the park are here suggested for those interested in amphibians and reptiles but who are not intimately acquainted with the region. Directions for reaching selected collecting grounds and approximate distances are given as well as brief accounts of the conditions encountered and species likely to be found.

All trips may be assumed to start from Park Headquarters at Frecks and the distances involved are reckoned from this point.

1 Field Trip to Breeds Run

Habitat of the Purple Salamander. Dusky and Allegany Salamanders are also to be found as well as Wood Frogs and Wood Turtles.

Follow main highway to Quaker Bridge (5½m.), cross Allegheny river and turn right on river road continuing north (6 m.) recrossing river at Red House; turn left following river road to Shongo (2¾ m.); bear right on dirt road to its end (about 1½ m.). Total distance 16 m.

Breeds run where it flows through the State Forest Experiment Station tract is one of the finest woodland streams in the park. Near the Experiment Station grounds the stream has but little fall and at places spreads to form small boggy areas. Along the stream itself and the little spring-fed tributaries the Purple, Dusky and Allegany Salamanders abound. The Purple Salamander is perhaps more abundant here than in any other section of the park. They should be looked for beneath logs and stones in the smaller streams, under similar retreats in boggy places and in springs. The larvae, which may attain a length of about four inches, are often found in numbers where the adults are not common. They are pale salmon in color with slightly darker markings on the back and sides and they possess gills. Wood Frogs and Wood Turtles may also be encountered here.

2 Field Trip to Peters Run

Habitat of the Timber Rattlesnake. In this rough area several species of snakes are likely to be encountered. In the meadows and open woods Milk, Garter and Smooth Green Snakes are fairly abundant. Leopard Frogs may be found in numbers in the low meadows bordering the Allegheny.

Follow main highway to Quaker Bridge (5½ m.), cross Allegheny river and take left turn, driving south on west side of river (5 m.); turn left and continue across Allegheny river to Onoville station on the Pennsylvania R. R. (¾ m.); continue past Peters Creek School as far as road will permit and follow up the valley on foot, keeping close to stream (1½ m.). Total distance about 13 m.

This is one of the wildest sections of the park and anyone entering the run should give some attention to the lay of the land and keep his directions in mind.

The lower reaches of this run cross broad level meadows, pastures and partially wooded open places. The low wet meadows near the Allegheny river are a favorite haunt of the Leopard Frog. The ascending hills flanking the run are densely covered with second growth hardwoods and near the top of the northeastern ridge there is a bold outcrop of the Salamanca conglomerate which forms a much broken rock wall of considerable length. The cracks and cavities in this conglomerate ledge are noted among the inhabitants of the region as being the denning up place for the Timber Rattlesnake. Peters run is one of the few localities where rattlesnakes occur in numbers within the park area. They may be encountered sunning themselves on the flat-topped blocks of conglomerate that have lodged here and there on the mountain side.

3 Field Trip to Limestone Hollow

Limestone Hollow should not be confused with Limestone village on Tunungwant creek east of the park.

Habitat of the Dusky and Allegany Salamanders. Here also is to be found the Timber Rattlesnake among the blocks of conglomerate on the hill sides.

Drive to Peters Creek School as indicated in directions for reaching Peters run. Park car and proceed on foot, following the dirt road leading northward (1 m.) to the entrance of the hollow. (The tracks of the Pennsylvania R. R. also lead to the hollow.) A walk of about one mile leads to a small stream flowing through a densely wooded glen. Total distance about 15 m.

The lower part of this picturesque hollow is shaded, wet and cool throughout the summer. The stream with its bed well furnished with loose shale makes the home of many salamanders (Dusky, Allegany, etc.). Higher up the character of the glen is not unlike that of Peters run. Numerous blocks of the Salamanca conglomerate have moved down the mountain side and make ideal retreats for the Timber Rattlesnake. Limestone hollow is locally celebrated because of the work of "Rattlesnake Pete" of Rochester who secured many specimens from this region.

4 Field Trip to Parker Mountain

Habitat of the Pilot Blacksnake.

Proceed eastward on Bradford road to new highway (5¼ m.) which leads northward through Halls to the McIntosh creek road in Red House valley (8 m.); bear right and follow McIntosh creek road to summit of Parker mountain (2¾ m.), now surmounted by a steel tower. Total distance about 16 m.

Alternative route. Proceed to Quaker Bridge (5½ m.), cross Allegheny river and turn right following river road to Red House (6 m.); continue east through Red House (2 m.) to McIntosh creek road; turn left and follow road to summit of Parker mountain (2¾ m.). Total distance about 15 m.

The north and east slopes of Parker mountain are the habitat of the Pilot Blacksnake. The sides of this and the surrounding mountains are covered with a characteristic open growth of young hardwoods. Here also are open places overgrown with the typical low heaths of the mountains such as Shin Leaf, *Pyrola secunda*, Pipsissewa, *Chimaphila umbellata*, Trailing Arbutus, *Epigaea repens* and Wintergreen, *Gaultheria procumbens*. The general character of the region is that observable in many of the dry hills of this section, but Parker mountain is the only locality in which the Pilot Blacksnake has been taken or reported within the park.

5 Field Trip to Bear Spring

Habitat of several species of salamanders, the Wood Frog and Wood Turtle.

From Headquarters proceed on foot up English run. A trip of about 2½ miles leads to a low wet area and one of the finest springs in the park. The last half mile of the trip is difficult. Follow trail markers nailed at intervals to trees.

East of the spot where Bear spring makes its appearance the land flattens out and tracts of considerable size are permanently wet, supporting great masses of luxuriant ferns of the genus *Osmunda*. Open places alternate with thick groves of trees. The Wood Frog is unusually abundant in this region.

6 Field Trip to the Lower End of Quaker Run

Habitat of the Mudpuppy. The clear, shallow water of this rock and stone-paved stream offers unusual facilities for the study of the Mudpuppy under natural conditions.

Follow Quaker Bridge road to first left turn past Quaker Indian School (4¾ m.); continue on dirt road (¾ m.) to bridge crossing Quaker run. Total distance about 5½ m.

Above the bridge for about one mile the bed of Quaker run provides an ideal habitat for the Mudpuppy. In early summer every stone suitably embedded in the stream bottom serves as a nest or retreat. Throughout the summer the adults and young may be found in the excavations beneath logs and stones. The water is clear and shallow except after heavy rains, and the bottom is hard except in the few deeper pools. Boots or shoes should be worn in wading over the slippery stones.

7 Field Trip to the Allegheny River at the Mouth of Wolf Run

This trip is outlined primarily for the study of the Hellbender but the meadows and fields bordering Wolf creek are prolific collecting grounds and Elko mountain west of the mouth of the creek is the home of the Timber Rattlesnake.

Proceed to Quaker run bridge as outlined for trip just preceding. Continue along dirt road which parallels the Pennsylvania R. R. tracks to Elko P. O. or Wolf Run station (1 m.). Park car at station and walk southward along tracks to mouth of Wolf run (¼ m.). Total distance about 6¾ m.

This trip should be attempted only when the river is low and the water clear. When the rocky spit extending from the mouth of Wolf run into the bed of the Allegheny is exposed above the surface of the river, the water is shallow enough to permit wading. Wade northward along the east side of the river where the bottom is covered with large, loose flakes of rock and flat stones beneath which the Hellbenders may be found. If the trip is made early in September, it should be possible to find the males occupying definite excavations, their nests, beneath flat stones on the bottom.

8 Field Trip to the Valley of the Tunungwant

Provision should be made for an all-day trip. The equipment should include a small seine, long-handled dip-nets, containers for aquatic species, and boots for wading. Frogs of various species will be encountered; turtles are more abundant here than elsewhere in the park area; and snakes of several kinds are sure to be found.

Follow main highway to Bradford, Pa. (10 m.); proceed on state highway north through Limestone village (6 m.); park car 2 miles north of Limestone and cross tracks of Erie and B. R. and P. R. R.; walk west across meadows and fields to Tunungwant creek. Total distance about 18 m.

The valley of the Tunungwant is one of the most fertile collecting grounds in the entire park area. The small ponds and backwaters harbor frogs of various species, Spotted and Painted Turtles, Water Snakes and Newts. In the stream itself and a few of the deeper permanent ox-bow ponds are to be found the Snapping and Musk Turtles, Bullfrogs and Green Frogs. Beneath logs in the swampy woods and along the banks the Spotted Salamander hides. In the low wet grounds bordering the stream search should be made for Butler's Garter Snake.

Plethodon wehrlei, a salamander not yet known from New York State, may be found in this valley as it has been collected in the Allegheny valley near Port Allegany, Pa. (See note below.)

9 **Field Trip to Willis Hollow**

Habitat of several woodland species of salamanders, the Wood Frog and Wood Turtle.

Follow main Quaker Bridge highway (¾ m.) to first house on right hand side of road. Park car and cross meadow, following poorly defined meadow road to foot bridge over Quaker run; bear south to mouth of Willis creek and proceed up the stream about one mile.

This is an excellent locality for Dusky, Allegany and Red-backed Salamanders, Wood Frogs and Wood Turtles. The hillsides are fairly rough but well wooded and traversed by old skid roads which may be followed to advantage.

Wehrle's Salamander, *Plethodon wehrlei* Fowler and Dunn

While this paper was passing through the press a number of specimens of *Plethodon wehrlei* was collected by Dr R. E. Coker and his class in field zoology. The salamanders were found high on the hillside opposite the Allegany School of Natural History, during the latter part of July. This is the first record of the species in the State.

Wehrle's Salamander is a slender species related to the group which includes *Plethodon glutinosus.* The color in life varies from deep brown to almost black except on the head and legs which are usually somewhat lighter. Light spots are present on the sides in the majority of specimens but are never as bright as in *P. glutinosus.* The throat is dirty white and the toes webbed at base. There are sixteen or seventeen costal grooves. The young are said to have paired red spots on the back. This species reaches a length of 152 mm (6 inches) but the average is about 110 mm.

Habits. Little is known of the habits of this species. In western Pennsylvania (near Port Allegany) where many specimens have been taken, they were found under logs and flakes of rock on hillsides and in old quarries, in fairly dry situations. In the park they occur in similar situations. Those taken were found on a wooded hillside covered with flat rocks, rotting logs and thick moist humus. The species is known only from Pennsylvania, New York, West Virginia and Indiana.

Jefferson's Salamander, *Ambystoma jeffersonianum* (Green)

A single large specimen of *Ambystoma jeffersonianum* was collected July 14, 1927 beneath the bark of a large decaying hemlock log in a little gully at the east end of Blacksnake Mountain. This interesting addition to the fauna of the park was made by Mr and Mrs W. P. Alexander.

Jefferson's Salamander reaches an extreme length of 185 mm (7¼ inches) but the average is about 162 mm (6⅜ inches). The mature individuals are almost uniform brown above with scattered flecks of pale blue on the lower sides. The young of the year and those two years old are more strongly marked and have the back, head and tail well spotted.

Habits. The adults are terrestrial except for the brief breeding period in early spring. Usually this species appears a few days before the Spotted Salamander and deposits its eggs in small, cylindrical masses attached to slender twigs. The masses contain on the average, about sixteen eggs but several masses may be attached to the same twig and form a continuous mass ten inches long. So far as now known the males of this species do not deposit spermatophores.

SUGGESTIONS FOR COLLECTING AND PRESERVING AMPHIBIANS AND REPTILES

Amphibians and reptiles are often abundant in particular localities but persistent collecting over a period of years will inevitably result in great reduction in numbers if not in extermination. It is neither necessary nor desirable to collect every specimen discovered unless a particular problem demands a complete census of a limited area. It *is* necessary to collect a sufficient number of specimens to establish the identity of species studied in the field.

Whenever logs or stones are moved in search of specimens, they should be returned to their original positions. If stones or rocks are loosened from a stream bottom, they should be replaced as carefully as possible. When collecting in running water, work up-stream and tip the stones or rock slabs *with the current* to permit rapid clearing of the roily water from the area disturbed. The current will also assist in raising a heavy object.

Specimens suddenly exposed often seek to escape in the cloud of roily water. Where this is a possibility, a net should be held against the stream bottom below the object turned.

The Rattlesnake is the only venomous species in the park area. It is confined to certain areas not suited to the uses of campers and tourists and should be allowed to persist. The commonest of the nonvenomous species are the Garter and Water Snakes and some reduction in their numbers would serve the double purpose of conserving the supply of toads, frogs and certain fish and of furnishing material for classroom use.

Information concerning various species, particularly observations on life-history and habits, is much to be desired; and small collections from various parts of the

State would add materially to our present knowledge of occurrence and distribution. In this connection, specimens sent to the State Museum will be identified and reported on.

Collecting Equipment

No elaborate equipment is needed for the collection of amphibians and reptiles and only a few special implements are required for their proper preservation. The items listed below will meet all the ordinary requirements of the collector in Allegany State Park.

Knapsack or game bag
Cotton bags
Wide-mouth jars
Small dip net
Long-handled dip net
Pocket knife
Collecting gun and ammunition
Field notebook and medium soft pencil
Small field labels
Tool for digging

The knapsack or game bag for carrying bags, jars and specimens should be provided with shoulder straps to leave the hands free. A creel or small botany can will serve if a knapsack is not available (figure 57*a*).

Muslin bags of various sizes for confining specimens are more easily carried than an equal number of cans or jars. The bags should be fitted with tapes or strings fastened on one side about two or three inches from the top. Those six inches wide and about ten inches long are convenient for most salamanders, small snakes and turtles (figures 57*b*, *c*). A few smaller ones for individual specimens should be provided, and at least one large stout bag for large turtles and venomous snakes (figure 57*d*). Five-pound sugar and salt bags will serve for many specimens.

Tight containers are necessary when eggs of frogs,

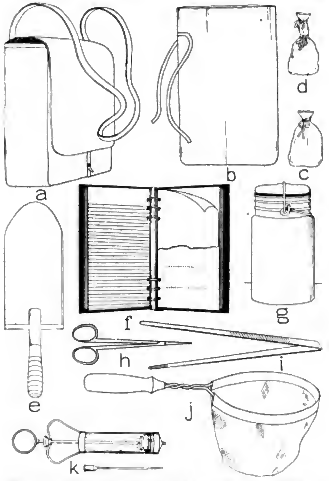

Figure 57 Illustrations of collecting equipment: a Knapsack or game bag. b Specimen bag. c Method of tying bag. d Method of tying for venomous snakes. e Digging tool. f Loose-leaf notebook. g Specimen jar. h Dissecting scissors. i Long forceps. j Pocket dip net. k Hypodermic syringe for injecting specimens

toads and salamanders are to be collected. Small fruit jars, pint and half-pint size, with spring-fastened tops are easily handled and not likely to break if ordinary care is taken (figure 57*g*). For carrying turtle and snake eggs and those of salamanders that lay on land, small wood or metal boxes are convenient.

Many specimens may be easily captured in the hands but certain aquatic species will usually escape unless a dip net is used. A small, short-handled dip net that may be carried in the knapsack is most useful in collecting tadpoles of frogs, toads and salamanders and for transferring egg masses to a container (figure 57*j*). If made of fine mesh the net may be used in capturing small aquatic organisms as food for specimens kept alive in aquariums.

A dip net fitted with a ring about 15 inches in diameter and a handle three or four feet long is convenient when collecting the larger salamanders, such as the Mudpuppy and Hellbender, pond turtles or frogs in streams and pools. The bag of the net should be fairly deep (about 20 inches will serve) and the mesh about one-half inch.

If large collections are to be brought together or a complete census of a pool or section of a stream is to be made, a small seine will be required. It should be of fine mesh, about 10 or 12 feet long and three feet deep. Fitted with leads and floats it may be rolled to occupy little space. The necessary brails for handling may be cut in the field or permanently attached. Trap nets are very useful for capturing small turtles in ponds and streams. They may be made of woven chicken wire of one inch mesh. The wire is rolled to form a cylinder about three feet long and two feet in diameter and either end (or both) fitted with a cone of wire opening inward.

Many snakes and salamanders will be found in and beneath rotting logs and stumps. Some kind of a digging tool, such as a light geologist's hammer or strong trowel, is more effective in opening logs than the bare hands and will prevent many bruises. The tool I have found most convenient to carry and use in the field is a flat, sharp-edged intrenching knife (figure 57*e*).

The field notebook is one of the most important items in the entire outfit. For convenience in carrying select one that will fit an outside coat pocket. The notebook may be of loose-leaf type or one that has the leaves permanently fastened. In my own experience I have found the loose-leaf kind more useful. Fillers of various kinds may be purchased, some lined for note taking, some with blank sheets for sketches and diagrams and a few perforated like postage stamps for use as temporary field labels (figure 57*f*). A medium soft lead pencil is better than ink for the field notebook which may be exposed to the weather or accidentally dropped into the water.

A collecting gun will be needed in the park only when extensive series of such species as the Water Snake or Pilot Blacksnake are desired. It is neither necessary nor desirable to carry a heavy gun into the field. A smooth bore, 44-calibre pistol with 12-inch barrel will serve every purpose. Cartridges with small powder charges and fine shot should be used. A 22-calibre target pistol bored smooth for shot cartridges is also good but less effective than the larger size.

Preserving Equipment

Materials and tools for preserving specimens will not be needed in the field unless trips covering several days are contemplated. The laboratory or camp should be provided with the following supplies:

Hypodermic syringe and needles.
Sharp knife or scalpel.
Small, sharp-pointed scissors.
Flat, rectangular pans of enamel or granite ware and tight covers.
Rubber gloves.
Graduate or measuring cup.
Jars, bottles, vials and stoppers to fit.

Snakes, turtles and the larger frogs and salamanders make better specimens when injected with a hypodermic syringe than when cut with knife or scissors. A syringe having a capacity of two or three ounces is large enough for any specimens likely to be found in the park. Needles of several sizes should be provided (figure 57*k*).

A sharp knife or scalpel will be useful for making small incisions when the hypodermic syringe is not available. For small delicate specimens the sharp-pointed scissors should be used (figure 57*h*).

For handling specimens in deep jars or in formalin, long forceps are needed. For ordinary use plain 12-inch "stuffing" forceps are best (figure 57*i*). For heavy specimens and for handling small venomous species, a pair of heavy placental forceps is necessary. Small forceps may be used for picking up individual eggs and small specimens such as salamander larvae and frog tadpoles.

Rubber gloves should be used when many formalin specimens are to be handled. The solution is very irritating in cuts and abrasions and hard on skin that is not broken.

Enamel or granite ware trays of various sizes may be used as receptacles for killing and relaxing specimens and for temporary preserving. Provided with heavy gauge galvanized iron covers, they may be stacked, one on top of the other, and will occupy little space.

A measuring cup or graduate will be needed in preparing solutions of various kinds. For determining the strength of alcohol, a floating graduated scale may be used.

Jars, bottles and vials of various sizes for permanent storage and preservation of specimens should be fitted with tight caps or stoppers. Glass fruit jars with spring-fastened tops and rubber rings are inexpensive and useful. Wide-mouth bottles will take many small specimens, eggs and larvae. For very large specimens, Snapping Turtles, snakes etc., glazed earthenware crocks may be used. For this purpose a special type has been manufactured. The top of the crock is provided with a deep groove which, when partially filled with heavy grease or wax, makes tight contact with a rim on the cover.

Chemicals

Alcohol 95-97 per cent ethyl
Sherings formalin
Chloretone crystals
Ether or chloroform
Caustic potash solution

Either alcohol or formalin may be used in preserving amphibians and reptiles. Satisfactory results are obtained when specimens are hardened in formalin and then transferred to alcohol for permanent storage.

Formalin solution of proper strength for hardening may be made by adding one ounce of commercial (40 per cent) formalin to 16 ounces of water. This will serve for both reptiles and amphibians. If specimens are to be left in the formalin solution permanently, a weaker mixture may be used, one part formalin to 20 parts water.

For preserving reptiles in alcohol a 75 per cent solution should be used; for amphibians, 55-60 per cent is strong enough. Eggs and larvae of amphibians may be placed directly in the weak formalin solution.

Chloretone for killing and relaxing amphibians may be purchased in crystal form and dissolved in water to make a saturated solution. An ounce or two of the solution added to a quart of water in a tight container will kill specimens without distortion and leave them perfectly relaxed. The specimens should then be arranged in flat trays of formalin solution for hardening. After 48 hours (and as much longer as convenient) they may be transferred to storage receptacles.

Ether and chloroform are rapid killing agents for snakes and turtles, or these animals may be killed by drowning in bags held entirely below the surface of the water.

After specimens have been killed and relaxed, they should be injected. Small salamanders and frogs may be placed in formalin solution without injection if the weather is cool. Large species, as the Mudpuppy, Hellbender, Green Frogs and Bullfrogs as well as snakes and turtles, should always be injected. In treating snakes the point of the syringe should be thrust beneath the ventral plates in several places as well as down the throat and in the vent. Large turtles should have the heavy leg muscles treated as well as the abdominal cavity.

The value of a collection depends on the care given to the preparation of the specimens and the accuracy and completeness of the data accompanying them. When specimens are secured in the field a temporary label should be placed in the container *at the time*. The label may bear a number which corresponds to one in the field notebook wherein the notes are recorded, or a slip giving exact locality, date and collector's name may be used and the notebook kept for more extended observations.

In my own work I have found it convenient to use perforated slips on which data of various kinds may be recorded. These slips are also valuable for recording notes when photographing specimens in the field. The name of the object photographed is given and the place, date, time and conditions of exposure. The slip, when pasted on the envelop holding the developed negative, becomes a permanent record of the entire operation.

When specimens have been killed, relaxed and hardened and are ready to place in storage jars, the permanent labels should be prepared and attached. A good label may be made by using the best grade white parchment or linen bond paper. It should be provided with a linen thread or light cord tied as shown in the appended figure (figure 58).

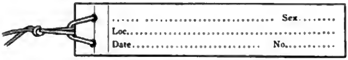

Figure 58 Sample label to show method of attaching string

The best grade of waterproof India ink, Higgins or Eternal, should be used and the label should bear the name of the specimen, the locality, date of collection and name of collector. Sex should be indicated if known and the field catalog number added. If the specimen is to become part of a permanent collection, it should receive a number corresponding to one assigned it in a record book or catalog of the collection. Labels should be attached as follows: For snakes, around the body about one-third of its length from the head; for salamanders, just behind the fore legs; for frogs and toads, just in front of the hind legs; for turtles, to one of the hind legs. The head and legs of turtles should be extended and the mouth held open by a wad of cotton before hardening.

Amphibians that have become dried may be almost completely restored by soaking for a short time in a very weak solution of caustic potash. A few drops of a ten per cent solution added to water sufficient to cover the specimens will restore the shape if not the colors.

FIELD KEY TO THE AMPHIBIANS AND REPTILES OF ALLEGANY STATE PARK

Adults

1 Skin without scales or plates; fingers and toes without claws ....(Amphibians) 2

Skin provided with scales or bony plates; legs present or absent but when present always with claws on at least some of the fingers and toes................(Reptiles) 19

2 Adults with tails..........................(Salamanders) 3

Adults without tails...................(Frogs and Toads) 12

3 Large, stout-bodied salamanders, eight inches long or over; aquatic 4

Small or medium size, less than eight inches long........ 5

4 With three pairs of external, bushy, red gills. *Mudpuppy*

Adults without gills, body with fleshy folds on sides *Hellbender*

5 Ground color of back and sides black with lighter spots or markings 6

Ground color red or pale salmon........................ 7

Ground color gray or brown............................ 8

Ground color yellow or olive green..................... 11

6 With large, rounded yellow spots on head, trunk and tail *Spotted Salamander*

With many small, irregular silvery white flecks on sides and back ....*Slimy Salamander*

7 Ground color bright coral red with many small rounded black spots on sides and back (old individuals with ground color darker and spots somewhat fused) *Red Salamander*

Ground color red or orange red; on each side a series of small black-edged vermilion spots; skin rough. *Newt* (land stage)

Ground color pale salmon with slightly darker reticulations; a light line from eye to nostril *Purple Salamander*

8 Ground color gray or lead color; with or without a broad dorsal band of red; belly dark......................... 9

Ground color brown or blackish; with or without a broad dorsal band lighter than sides; belly light............. 10

9 A broad red band along middle of back *Red-backed Salamander*

Uniform dark gray or lead color above *Red-backed Salamander* (Dark phase)

10 Dull brown to blackish above; an indistinct light line from eye to angle of jaw; tail somewhat keeled above *Dusky Salamander*

A broad median light band; broad dark lateral bands with straight upper edges; an indistinct light line from eye to angle of jaw; often with a narrow dark line or series of spots along mid-line of back; tail round *Allegany Salamander*

11 Ground color yellow above and below; a dark line along each side of back; body small and slender; tail flattened *Two-lined Salamander*

Ground color dull yellow to olive green above; belly yellow with small black specks; sides with a series of small red, black-edged spots; skin smooth *Newt* (aquatic adult)

12 Tips of toes expanded to form disks.................... 13

Tips of toes not expanded.............................. 14

13 Skin rough; undersurfaces of hind legs and groin yellow; length about two inches........*Tree Toad, Rain Frog*

Skin smooth; back with a dark cross-shaped mark; length about one inch..........................*Spring Peeper*

14 Skin rough and warty; legs short and stout; a pair of prominent kidney-shaped glands on back of head *American Toad*

Skin smooth; legs long; no prominent glands on back of head 15

15 Size large, five to six inches; no fleshy ridge along each side of back..................................*Bullfrog*

Size small to large, two to five inches; a fleshy ridge along each side of back.................................... 16

16 With very conspicuous rounded or squarish spots on back between fleshy ridges................................ 17

Without very conspicuous rounded or squarish spots on back between fleshy ridges............................ 18

17 Ground color generally brown; spots between fleshy ridges squarish; lower surfaces of hind legs, groin and lower belly bright yellow......................*Pickerel Frog*

Ground color generally greenish; spots between fleshy ridges rounded or elongate and with light margins; usually no yellow on underparts....... *Leopard Frog*

18 Size small, two inches or less; ground color generally some shade of tan; a prominent elongate black patch on sides of head in ear region.................*Wood Frog*

Size large, four to five inches, head and upper back usually bright metallic green; lower back and sides sometimes darkly spotted; throat of male yellow.....*Green Frog*

19 Body provided with a bony shell; no teeth; legs present (Turtles) 20

Body without a bony shell; teeth present; legs absent (Snakes) 24

20 Belly shell or plastron small and cross-shaped; fleshy parts much exposed.. 21

Belly shell or plastron large; fleshy parts mostly covered 22

21 Size small, four inches or less; upper shell strongly arched, smooth and with margins entire; tail short.*Musk Turtle*

Size large, 14 inches or less; upper shell rough, hind margin deeply notched, tail long......*Snapping Turtle*

22 Plates of upper shell smooth........................... 23

Plates of upper shell roughened with deep concentric grooves; fleshy parts brick red...........*Wood Turtle*

23 Upper shell dark brown or black marked with many small rounded yellow spots...................*Spotted Turtle*

Upper shell olive brown to black; marginal plates marked with red; plastron yellow with a dark central figure *Western Painted Turtle*

24 Tip of tail provided with a rattle............*Rattlesnake*

Tip of tail not provided with a rattle.................. 25

25 Scales entirely smooth, without keels or ridges.......... 26

Keels or ridges present on at least some of the scales.... 28

26 With blotches or cross-bands; belly checkered, black and white; scales in 21 rows....................*Milk Snake*

Without blotches or cross-bands.......................... 27

27 Ground color dark gray or black; back of head a yellowish or white ring.........................*Ring-neck Snake*

Ground color grass green...................*Green Snake*

28 All scales keeled....................................... 29

A few dorsal rows only, keeled; scales in 25–27 rows; color nearly uniform black, sometimes slightly blotched *Pilot Blacksnake*

29 With three light longitudinal stripes or bands............ 30

Without longitudinal stripes or bands, or with a single median band 32

30 Light stripes of sides anteriorly on third and fourth rows of scales; scales in 17 or 19 rows..................... 31

Light stripes of sides on second and third rows of scales; a double row of square dark blotches on sides between dorsal and lateral light stripes; scales in 19 rows *Garter Snake*

31 Body long and very slender; light stripes of sides confined to third and fourth rows of scales; scales in 19 rows *Ribbon Snake*

Body not conspicuously slender; light stripes of sides anteriorly on third and fourth rows of scales, posteriorly on second and third rows; scales in 17–19 rows *Butler's Garter Snake*

32 With cross-bands or blotches; scales in 23 rows *Water Snake*

Without cross-bands or blotches; a light dorsal stripe usually present 33

33 Belly bright red; three small light spots back of head; scales in 15 rows....................*Red-bellied Snake*

Belly whitish or pinkish; back with a clay-colored longitudinal band; scales in 17 rows.........*DeKay's Snake*

(See also descriptions of *Plethodon wehrlei* and *Ambystoma jeffersonianum* (p. 117) discovered too late in the park to be included in the key.)

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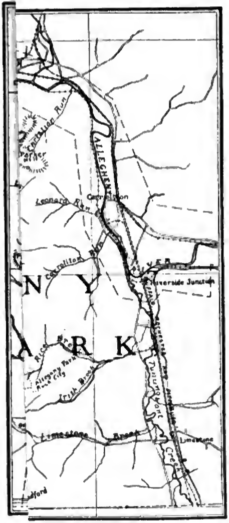
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RIVER
Leonard Run
Carrollton
Carrollton Run
Riverside Junction
N Y
A R K
Rice Brook
Allegany Park
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Irish Brook
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adford

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A. H. Wright

NOTES ON SOME AMPHIBIANS AND REPTILES FROM THE SOUTHEASTERN STATES WITH A DESCRIPTION OF A NEW SALAMANDER FROM NORTH CAROLINA

By SHERMAN C. BISHOP

PLATES 23–26

This paper puts on record the results of a collecting trip, in October 1926, to the mountains of eastern Tennessee, western North Carolina and northern South Carolina and Georgia. On my first trip to the Blue Ridge mountains, in October 1923, collections were made on Mt. Mitchell, Grandfather Mt., the foothills near Black Mt. and the lower slopes of Mt. Pisgah. The 1926 itinerary included Frying Pan Mt., Big Bald Mt., Mt. Pisgah to the summit and Wayah Bald in North Carolina and Mt. LeConte of the Great Smokies in Tennessee. Short visits were made to various other localities in South Carolina and Georgia. I have also included some records of specimens secured at various times from friends and correspondents. Particular mention may be made of the series of salamanders collected by Mr. K. F. Chamberlain of the New York State Museum, in Virginia and Tennessee. I would also acknowledge my indebtedness to Professor C. R. Crosby and Doctor Forest M. Blodgett of Cornell University with whom the trip was made and who contributed many specimens.

The drawings were made by Mr. Walter J. Schoonmaker of the New York State Museum; the photographs of living specimens by Mr. E. J. Stein of the State Museum and the writer.

The mountains of western North Carolina have received considerable attention from herpetrologists, collections having been made and reported on by Brimley ('12, '26, '27), Dunn ('17, '20), Breder and Breder ('23), Pope ('24), Noble ('27) and the writer ('24). Much remains to be accomplished, however, particularly in the study of life histories, habits and habitat relationships. It should be emphasized that the habits and habitat preferences of the various species can never be determined fully until studies are carried on throughout the year over a considerable number of years. Observations covering a period of a few days or weeks are of value for the particular time and place but furnish slender grounds for conclusions of a general nature. In October 1923 many localities were visited during a protracted drouth, the streams being shrunken to half their normal flow. In these the salamander population was concentrated, many species being thrown together that usually, perhaps, would have occupied more distinct habitats.

Dunn ('26, p. 17) writing of *Desmognathus phoca* and *D. quadra-maculatus* says: "Instead of being, like *quadra-maculatus*, an animal of the streams, it (*phoca*) is a creature of the banks of smaller brooks." My own observations, in the main, confirm those made by Dunn but neither species is strictly confined to one type of stream or the other. In one small mountain brook on the southwest side of Grandfather Mt., N. C., both species were found and in addition *Leurognathus marmorata*. Where the stream is of considerable size, there is *some* evidence of segregation, the majority of specimens of *phoca* being found along the margins, *quadra-maculatus* beneath stones in swifter waters and *marmorata* in the pools.

Noble ('27, p. 2) makes clear distinctions between stream types and remarks concerning these species: "I have never found an adult *quadra-maculatus* in a muddy trickle or an adult *phoca* in a rocky stream, but half grown individuals occur in both types of habitats." The Grandfather Mt. stream mentioned above fulfills all the requirements of a muddy trickle, being moss grown, leaf choked and mud-bottomed. The water, however, was clear and beneath the moss and rubbish I collected larvae, half grown individuals and adults of both species. These observations do not discredit the statements made by others; they do emphasize the necessity of being cautious when making general statements based on limited field experience.

In discussing D. *quadra-maculatus* in an earlier paper ('24, p. 94) I wrote: "In life it may be associated with the smaller *Desmognathus phoca* and *D. ochrophaeus carolinensis* although the latter species is also found in situations that do not prove acceptable to *D. quadra-macula-*

tus." I would modify this statement only by including *D. fuscus fuscus*, *Gyrinophilus danielsi* and *Eurycea bislineata wilderae* among the species that may be associated with *quadra-maculatus* in the streams or along their margins.

In discussing the habitat preferences of salamanders it is necessary to consider not only temporary changes in habitat associated with breeding habits or transformation but seasonal changes and those enforced by periods of drouth and excessive rainfall. Furthermore, the habits and habitat preferences of certain widely distributed species vary somewhat in different parts of the range. Certainly not enough work has been done in the Blue Ridge mountains to justify final conclusions.

The definite collecting localities listed below are those which proved exceptionally productive of salamanders and are given in the hope that they may be of service to others who may visit the region.

Mt. LeConte of the Great Smokies, may be reached conveniently from Gatlinburg, Tennessee. We collected on the mountain itself and in the vicinity of Gatlinburg from October 7th to the 11th. From Gatlinburg two well marked trails lead to the summit of LeConte from which an endless vista of forest and mountain spreads away on all sides. The foot trail by way of the Cherokee Orchards follows, in general, the course of Mill Creek. In this stream and along the margins, *Desmognathus quadra-maculatus* (Holbrook) is the most abundant salamander and outnumbers all the other species together. *Desmognathus fuscus fuscus* (Raf.), *D. fuscus carolinensis* Dunn and *D. phoca* (Matthes) occur sparingly. Beneath stones at the stream margin were a few individuals of *Eurycea bislineata wilderae* Dunn. Under stones and logs bordering the trail through the forest of spruce and poplar, *Plethodon jordani Blatchley* and *Plethodon glutinosus* (Green) were found. Near the summit of Mt. LeConte, in the springs at the source of Roaring Fork, *Gyrinophilus danielsi* (Blatchley) was abundant and associated with *Desmognathus quadra-maculatus* (Holbrook). Almost at the extreme summit of the mountain and a considerable distance from the nearest water several large specimens of *Eurycea bislineata wilderae* Dunn, were found under logs and stones or buried deeply beneath the thick ground covering of moss and leaf mold.

On October 12th we reached Frying Pan Gap near Big Pisgah, N. C. and camped for the night in the rain. The springs and streams nearby furnished a few specimens of *Gyrinophilus danielsi*, *Desmognathus quadra-maculatus*, *D. fuscus carolinensis* and *Eurycea bislineata wilderae*.

The forests of oak, chestnut, *Cornus* and *Rhododendron* covering the slopes of Frying Pan Mt. above camp yielded *Plethodon metcalfi* Brimley in considerable numbers.

The trail up Big Pisgah from the "Lodge" to the summit passes through forests of oak and chestnut with an undergrowth of *Rhododendron*. Balsam and spruce occur very sparingly. Under logs and stones in the denser parts *Plethodon metcalfi* is the conspicuous salamander. In the damper areas and along streams *Desmognathus fuscus carolinensis* occurs.

From Mt. Pisgah our way led to the Nantahalas which we reached on the night of October 15th and camped by the side of the road at the base of the eastern slope. On the morning of the 16th, collecting on foot up the road to the Pass (Wayah or Nantahala) a few specimens of *Plethodon shermani* Stejneger were discovered under logs and slabs of wood or rarely beneath loose flakes of rock. *Desmognathus fuscus carolinensis* was fairly abundant and beneath a log far away from water, a single specimen of *Gyrinophilus danielsi* was found.

The most conspicuous animal of the Nantahalas is the razorback hog, pastured here by hundreds and ranging from base to the extreme summit. Only on the most precipitous slopes is it possible to find a place where they have not completely rooted out the smaller undergrowth and turned over the leaf mold. Logs and stones are thrust aside in the search for acorns and chestnuts and salamanders and other small creatures are taken when found. Streams and springs are gutted and roiled in the search for crayfish and salamanders. The collector interested in the fauna of the leaf mold finds that the hogs have been there before him mixing the leaves with the soil beneath and exposing all to the air to become dry as tinder. It is to be regretted that this scenic wonderland and a part of the National Forest is allowed to develop into a hog wallow.

The sparsely wooded slopes above the village of Tallulah Falls and the tree covered side of the Tallulah gorge itself were searched for specimens of *Aneides aeneus* and a single specimen secured.

Order CAUDATA

Family SALAMANDRIDAE

Triturus viridescens viridescens (Raf.)

Tennessee: Crabtree, July 9, 1927, 4 ads. K. F. Chamberlain, coll.

Family AMBYSTOMIDAE

Ambystoma opacum (Gravenhorst)

Plate 23, figure 4

Seventeen specimens collected under logs and bark in a branch of the Congaree River swamp are remarkably uniform in size and average only 69.1 mm. in length. The shortest and longest specimens are 55 and 79 mm. long respectively but fourteen of the seventeen specimens vary only from 65 to 75 mm.

South Carolina: Congaree River swamp west of Sumter, Oct. 20, 1926, 17 specimens.

Virginia: Nottoway River swamp 8 miles south of Franklin, Oct. 26, 1926, 1 ♂, 1 yg.

Ambystoma mabeei nov. sp.

Plate 23, figures 1 and 2

Type: U. S. Nat. Mus. No. 75058, collected by W. B. Mabee in the low grounds of the Black River near Dunn, N. C., May 12, 1923.

Mr. C. S. Brimley has mentioned this specimen (Copeia, No. 162, p. 10, 1927) under the name *Ambystoma microstomum* and described the color in life as brown above with lighter spots on the sides.

Body short and stout; head small, narrow; snout short and bluntly rounded. There are thirteen costal grooves if two that run together in the groin and one in the axilla are considered; two intercostal spaces between the appressed limbs; toes four-five; plantar and palmar tubercles present but not well developed; gular fold well developed.

The color in alcohol is uniform slate gray above, slightly lighter beneath and with only an indication of the lateral pale spots which were present in life.

The tail is thick and glandular and marked with about nine impressed vertical lines; there is an indistinct median dorsal line extending from a point above the fore legs to one above the vent and a slight ventral line of about the same extent. The dorsal surface of the head and trunk is smooth and shining. The teeth are in a transverse series interrupted behind the inner nares and extending somewhat outside them; middle line of teeth nearly straight and entire, the outer series set at an angle; tongue oval and provided with a median groove, the plicae meeting it obliquely. Total length 100 mm; tail from posterior end of vent 40 mm.

This species is obviously related to the group which includes *A. jeffersonianum*, *A. opacum* and *A. maculatum*. There is a superficial resemblance to some specimens of *A. texanum* (*microstomum*) (particularly old and faded individuals), but constant difference in number of costal grooves, the arrangement and number of the teeth and in the shape and proportions of the body. The body proportions are more nearly those of *A. opacum* from which it differs strikingly in color, in the number of costal grooves (11 or 12 in *A. opacum* and 13 in *A. mabeei*), in the character of the tongue which has a definite median groove, and in the size and shape of the head. To a less degree, the teeth also differ from those of *A. opacum*.

Compared with a specimen of exactly the same length, the differences in proportions are immediately evident and may be summarized briefly in tabular form:

	HEAD		TRUNK	TAIL		
	Length	Width	Distance between legs	Length	Width	Depth
	mm.	mm.	mm.	mm.	mm.	mm.
opacum	15	12	27	40	6	8
mabeei	13	11	32	40	8.5	10

The tail of *A. mabeei* has a depth almost uniform to the tip which is abruptly pointed. In *A. opacum* the tail gradually tapers. *Ambystoma talpoideum*, which is uniformly colored in preservative, differs in having fewer costal grooves, a much larger head, and tongue without a median groove.

The mouth parts of several species with which *A. mabeei* has been compared in the preceding paragraph are shown in detail in the appended figures (pl. 23, figs. 3–5).

A larva approaching transformation at a length of 63 mm. taken by Mr. C. S. Brimley at Andrews, N. C., May 1908, may be this species. It is uniform dull brown above, lighter below and with a series of small light spots on the sides between the legs. The costal grooves are 13 as in the Dunn, N. C., specimen and the plantar tubercles are present though not well developed.

I am indebted to Mr. Brimley for the privilege of describing this species.

Family PLETHODONTIDAE

Plethodon cinereus (Green)

North Carolina: Andrews, Oct. 17, 1926, 2 ads.

Plethodon glutinosus (Green)

North Carolina: Big Bald Mt., Oct. 13, 1926, 1 ad.; Andrews, Oct. 17, 1926, 2 ♂, 1 ♀.

Tennessee: Mt. LeConte, Mill Creek, 2500–3000 feet elev., Oct. 7, 1926, 2 ads.; Elkmont, Laurel Creek, Oct. 8, 1926, 1 ad.

Georgia: Tallulah Falls, Oct. 18, 1926, 3 ads; Dick's Creek Gap, on line between Rabun and Towns counties, Oct. 18, 1926, 1 ♂, 1 yg.

Virginia: Buffalo Creek 6 miles south of Lexington, July 5, 1927, 1 ad., K. F. Chamberlain, coll.

Mississippi: Clinton, May 1926, 8 ads., J. W. Bailey, coll.

The Mississippi specimens are characterized by strong spotting above and the fusion of the spots on the lower sides to form conspicuous bands, not complete, but much more so than in northern specimens. The spots on some are continued to the tip of the tail and in every specimen there is a lack of the dull brown color of the distal third of the tail which is characteristic of specimens from the north.

Plethodon jordani Blatchley

Plate 24, figure 9

This species did not seem to be particularly abundant on Mt. LeConte at the time of our visit. The smaller specimens were usually taken by sifting leaf mold and the larger individuals by turning stones and logs along the Mill Creek trail. The first specimens were found at an altitude of about 2500 feet. Above the falls *P. jordani* runs up to well over 5000 feet.

The smaller specimens varied in length from 29 mm. (tip of tail lost) to 55 mm. and the larger from 81 to 92 mm.

The color of the cheek patch varies from light pink to bright red in different individuals and some difference in color may be noted in the same individual if kept under observation for a few weeks.

Tennessee: Mt. LeConte, Mill Creek, 2500 to 3500 feet alt., Oct. 7, 1926, 3 young in leaf mold and under logs; Mill Creek above falls, Oct. 9, 1926, 3 young and 1 adult; Mill Creek below falls, Oct. 9, 1926, 3 adults.

Plethodon metcalfi Brimley

Plate 24, figure 7

This species is everywhere abundant at higher altitudes on Big Pisgah, Big Bald, and Frying Pan Mt. in western North Carolina. Under logs and stones imbedded in the thick leaf mold of the forests covering Frying Pan Mt., it is the dominant species. The woods here are chiefly of oak and chestnut with an undergrowth of *Cornus* and *Rhododendron*. Specimens appeared to be more abundant in the open, glade-like areas and along the trails than in the dense tangles of *Rhododendron*. On Mt. Pisgah and Big Bald Mt. we found no specimens above the limit of large tree growth.

North Carolina: Frying Pan Mt., Oct. 13, 1926, 20 specimens of both sexes, the larger individuals varying in length from 70 to 124 mm. and the smaller from 49 to 59 mm. The largest specimen taken here was a female 124 mm. long. In this the tail measured 62 mm. from posterior end of vent to tip. Three males measured respectively, 100, 106 and 123 mm. with corresponding tail measurements of 53, 52 and 67 mm.; Big Bald Mt., Oct. 13, 1926, 7 specimens; Mt. Pisgah, Oct. 14, 1926 (Lodge to summit) 17 specimens, the largest, a female, 135 mm. long with a tail length of 70 mm.; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 2 specimens.

Plethodon shermani Stejneger

Plate 24, figure 8

On the east side of Wayah Gap, the greater number of specimens were found in the shelter of logs and old planks, only a few beneath stones. The first specimens were secured at the site of an abandoned road camp at an altitutde of about 3,000 feet; widely scattered specimens were found thereafter until an altitude of about 5000 feet was reached.

The amount of red on the legs varies considerably. In one specimen the red was lacking except for a few minute flecks.

North Carolina: East side of Wayah Gap, Oct. 16, 1926, 15 specimens. In 13 of the 15 specimens the length varied from 90 to 149 mm.; the two smaller specimens measured 45 and 59 mm. respectively; Wayah Gap, Oct. 16, 1926, altitude 4100 feet, 3 specimens from beneath a large log; Wayah Gap to summit of Wayah Bald, Oct. 16, 1926, 1 adult 116 mm. long. Only a single specimen was found on the higher slopes of Wayah Bald. The scarcity may have been due to the extremely dry condition of the forest floor combined with the activities of the razor-back hogs; west side Wayah Gap, Oct. 16, 1926, 6 specimens collected from beneath logs and stones in a *Rhododendron* thicket bordering a little stream near the base of the mountain about two miles east of Aquone, N. C.

Stereochilus marginatus (Hallowell)

A single specimen was raked out of a small pool at the edge of a swamp bordering the State highway near Whitakers, N. C. It was taken in company with a number of specimens of *Desmognathus fuscus fuscus* but was not recognized until the material was examined in the laboratory.

The pool, a shallow depression at the end of a road culvert, was filled with rotting leaves and a few growing plants and there was little indication of a current.

North Carolina: Whitakers, Oct. 25, 1926, 1 adult 83 mm. long; tail 34 mm.; altitude about 116 feet.

Gyrinophilus danielsi (Blatchley)

Plate 26, figure 14

This species reaches its best development at high altitudes. In such situations it is not only more abundant but attains a larger size and is more strikingly marked. Specimens from near the summit at Mt. LeConte, Tenn., are sparsely spotted above on a ground color that approaches that of *Pseudotriton montanus*.

North Carolina: East side of Wayah (Nantahala) Gap, Oct. 16, 1926, 1 adult beneath a log at the side of the road; Frying Pan Mt., Oct. 13, 1926, 1 adult; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 1 adult, 115 mm. long with a specimen of *Plethodon metcalfi* 82 mm. long in the stomach, a fragment of another salamander and a large tipulid larva; between Swain and Emma, Oct. 15, 1926, 1 larva, 110 mm. long.

Tennessee: Mt. LeConte (near summit) Oct. 10, 1926, 7 adults, 2 larvae; Mill Creek, Mt. LeConte (below falls), 1 larva, 55 mm. long; Cave near Three Springs about 2 miles north of Russellville, 1926, 1 adult, 135 mm. long but with tip of tail lost. J. D. Ives, coll.

The Mt. LeConte specimens were taken in a spring run near the summit of the mountain at an altitude of about 6400 feet. The two larger specimens in the series were females, one of which measured 165 mm. in length and contained mature eggs in the ovaries. A second female measured 154 mm. in length and two males were 130 and 135 mm. respectively.

The specimen from the cave near Three Springs was taken about 800 feet from the entrance, in total darkness. It is pale in color with poorly defined spots.

Pseudotriton ruber schencki (Brimley)

Plate 26, figure 16

Only two specimens were secured. The North Carolina specimen is apparently an adult with the black chin and other characters of the subspecies but with the dorsal spots tending to fuse.

North Carolina: Wilmot, Oct. 15, 1926, 1 adult.

Tennessee: Juncture of Rough Creek and Little River near Elkmont, Oct. 8, 1926, 1 small specimen 85 mm. long. Under moss covering the gravelly bed of a small trickle.

Eurycea bislineata bislineata Green

North Carolina: Weldon, near Jackson, Oct. 26, 1926, 1 adult, 5 larvae.

Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 1 adult. The Elkmont specimen is marked exactly like many specimens from New York and New England. At the same time and place specimens having all the characters of the subspecies *wilderae* were taken.

Eurycea bislineata wilderae Dunn

Plate 24, figure 6

Mt. LeConte specimens average considerably larger than those recorded by Dunn (1926, p. 312). Dunn's largest specimen, a male, measured 93 mm., his largest female 90 mm. Fifteen males from Mt. LeConte have an average length of 94.6 mm. with extremes of 86 and 110 mm. Five females average 95 mm. in length, the largest, 106 mm. The color pattern is striking and while it is essentially the same as in specimens from Mt. Mitchell, N. C., it appears to be more conspicuously developed. The dark band on the sides is often broad and may continue unbroken to the tip of the tail. The dorsal markings are extremely variable. Between the lateral dark bands the back may be almost immaculate or finely specked. In other specimens a single broken, mid-dorsal line is present. In still others the spots are of large size and scattered irregularly over the surface. Below the lateral bands the sides may be strongly mottled with black and yellow (in several old females), or lightly flecked.

North Carolina: East side Wayah (Nantahala) Gap, Oct. 16, 1926, 2 specimens, one a female with well developed eggs in the ovaries; Wayah Gap, Oct. 16, 1926, alt. 4100 feet, 1 small specimen; west side Wayah Gap, Oct. 16, 1926, 2 adults; Frying Pan Mt., Oct. 13, 1926, 1 ♀ with large eggs in ovaries.

Tennessee: Mt. LeConte (Mill Creek, 2500 to 3500 feet elevation) Oct. 7, 1926, 5 ♂, 2 ♀, 2 yg. Two of the five males were without cirri; Mt. LeConte (near summit, about 6400 feet elevation), Oct. 10, 1926, 11 ♂, 2 ♀, 4 yg. and 5 larvae; Mt. LeConte, Mill Creek below falls, Oct. 9, 1926, 1 ♂, 1 ♀, 3 recently transformed and 2 larvae; Mt. LeConte, Roaring Fork, Oct. 10, 1926, 3 ♀; Rough Creek near Elkmont, Oct. 8, 1926, 1 ♂, 6 larvae.

Eurycea gutto-lineata (Holbrook)

Louisiana: Baton Rouge, Nov. 27, 1926, 1 adult, C. A. Brown, coll.

Eurycea lucifuga Rafinesque

Tennessee: Cave near Three Springs, 1926, 1 adult, J. D. Ives, coll. Taken near entrance of cave in twilight zone; Jefferson City, April 18, 1927, 1 adult, J. D. Ives, coll.

Aneides aeneus (Cope and Packard)

Plate 25, figures 10–12

A single specimen was taken Oct. 18, 1926 at Tallulah Falls, Ga. where several years ago the species was collected by Dr. J. Chester Bradley of Cornell University. Unfortunately, at the time of our visit, there had been no rain for several weeks and the woods were exceedingly dry. Like many other supposedly rare salamanders, this species will be found in abundance if search is made earlier in the season in suitable situations. I have specimens from Kentucky without definite locality records but possibly from Pine Mt., Harlan County, where the species is abundant.

The colors and pattern of this species have been imperfectly described. In life the ground color of the back and upper sides of a typically marked specimen is black with many irregular, greenish-yellow lichen-like markings. The legs are lighter with yellow predominating in small specimens. The belly and under surfaces of the legs light yellow. The toe disks are well developed and enable the salamander to run with surprising agility on vertical surfaces or even in an inverted position. The 107 mm. specimen collected by Mr. J. O. Pepper on Mt. Pinnacle, S. C., at an altitude of about 2000 feet was found in damp woods on the trunk of a tree about three or four feet from the ground. (See Brimley, Copeia, No. 162, 1927, p. 10.) During the dry period such as experienced at Tallulah Falls, Ga., no specimens were found exposed on the trunks of trees. The single specimen was hiding beneath a piece of bark lying on the surface of a rock two or three feet above the ground in very dry open woods.

The species is extremely agile and lizard-like in its movements and can leap several times its own length. In captivity it feeds well on fruit flies, capturing them with swift snapping movements.

Desmognathus fuscus fuscus (Raf.)

Typically marked specimens were fairly abundant at high altitudes on Mt. LeConte, Tennessee. Tallulah Falls, Georgia, specimens are considerably smaller, more slender and in some respects approach *D. fuscus carolinensis*. The widest departure from normal is found in a small series from Demorest, Georgia. In these the back and upper sides are very dark and the lower sides strongly mottled, black and yellowish-white. Lighter markings are also present on the dorsal tail keel and conspicuously on the snout and fore part of the head. The anterior half of the throat is light but back of this the entire venter is either uniform dark, much as in *Desmognathus quadra-maculatus*, or strongly mottled.

North Carolina: Whitakers, Oct. 25, 1926, 7 ads., 1 yg.; east fork of the Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 3 ads., 3 yg.

Tennessee: Mt. LeConte, Oct. 10, 1926 (altitude, 6400 feet) 10 adults varying in length from 78 to 101 mm.; Mill Creek, Mt. LeConte, Oct. 9, 1926, 2 ads., 4 yg.

Georgia: Tallulah Falls, Oct. 18, 1926, 3 ads, 4 yg.; Demorest, April, 1926, 3 ads., M. E. Phillips, coll.

Virginia: Buffalo Creek, 6 miles south of Lexington, July 5, 1927, 13 ads., 4 yg.

Desmognathus fuscus auriculatus (Holbrook)

North Carolina: Maysville, Oct. 23, 1926, 1 ad., 1 yg.; Weldon, Oct. 26, 1926, 1 ad. 88 mm. long, tail 44 mm.

Desmognathus fuscus carolinensis Dunn

Plate 25, figure 13

North Carolina: Big Bald Mt., Oct. 13, 1926, 4 ads.; Mt. Pisgah (Lodge to summit), Oct. 14, 1926, 11 ads.; Frying Pan Mt., Oct. 13, 1926, 4 ads., 3 yg.; Wayah Bald, Oct. 16, 1926, 1 ad. 1 yg.; Wayah Gap, Oct. 16, 1926, 3 ads.

Tennessee: Mill Creek, Mt. LeConte, Oct. 7, 1926, 2 yg.; Mill Creek, Mt. LeConte, Oct. 9, 1926, 2 ads. 1 yg.; Roaring Fork, Mt. LeConte, Oct. 10, 1926, 2 ads.

Georgia: Dick's Creek Gap on line of Rabun and Towns counties, Oct. 18, 1926, 1 ad.

Dunn (Copeia, No. 164, 1927, p. 84) has recently described a new mountain race of *Desmognathus* from Indian Pass, N. C., to which the name *D. fuscus imitator* has been given. The specimens listed above from Mt. LeConte may perhaps, with propriety, be regarded as intergrades between typical *carolinensis* and *imitator* for, as Dunn has pointed out, they are unusually dark below and have the dorsal pattern somewhat obscured.

Two specimens from Roaring Fork, Mt. LeConte, however, seem to me to approach *D. fuscus fuscus* in the form of the body and the slightly keeled tail but in the dorsal pattern and dark venter they are typical *carolinensis*.

Desmognathus phoca (Matthes)

North Carolina: Wilmont, Aug. 15, 1926, 3 ads.; between Swain and Emma, Oct. 15, 1926, 1 ad.; east side of Wayah Gap, Oct. 16, 1926, 3 ads.; Andrews, Oct. 17, 1926, 5 ads.

Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.; Mt. LeConte, Oct. 7, 1926, 1 young (atypical); Crabtree, July 9, 1927, 16 ads., 19 yg., K. F. Chamberlain, coll.; Crabtree July 11, 1927, 4 ads., 6 yg., K. F. Chamberlain, coll.

Georgia: Demorest, April 1926, 1 ad., M. E. Phillips, coll.

The Andrews, N. C., specimens are very dark above, the pattern being largely obscured. The largest specimens from Crabtree, Tennessee, measure respectively 131 and 129 mm. in length, the smallest transformed specimen 42 mm.

Desmognathus quadra-maculatus (Holbrook)

Plate 26, figure 15

North Carolina: East side Wayah Gap, Oct. 16, 1926, 16 ads., 1 yg.; Wayah Gap, Oct. 16, 1926 (4100 feet elev.), 1 ad.; Wayah Bald, (4100 to about 5000 feet) Oct. 16, 1926, 3 ads., 1 larva; Frying Pan Mt., Oct. 13, 1926, 3 ads.; east fork of Pigeon River near mouth of Hungry Creek, Oct. 12, 1926, 2 ads.; between Swain and Emma, Oct. 15, 1926, 3 ads.

Tennessee: Mt. LeConte, Mill Creek below falls, Oct. 9, 1926, 15 ads., 2 yg., 3 larvae; Mill Creek above falls, Oct. 10, 1926, 7 ads., 1 larva; Mt. LeConte, Oct. 7, 1926, (2500–3000 feet elev.), 23 ads.; Mt. LeConte, Oct. 10, 1926 (6400 feet), 5 ads.; Mt. LeConte, Roaring Fork, Oct. 10, 1926, 2 ads.; Laurel Creek near Elkmont, Oct. 8, 1926, 2 ads.; Crabtree, July 11, 1927, 1 ad., 2 yg., K. F. Chamberlain, coll.

Georgia: Tallulah Falls, Oct. 18, 1926, 1 yg. (atypical).

The largest specimen, 170 mm. long, was taken near the summit of Mt. LeConte at an elevation of about 6400 feet. The smallest fully transformed specimen measures only 61 mm. in length.

Leurognathus marmorata Moore

North Carolina: Frying Pan Mt., near Big Pisgah, Oct. 13, 1926, 1 ad.

A single large specimen from a spring run near the summit was taken with several specimens of *Desmognathus quadra-maculatus.* The color pattern is peculiar. There are two widely separated rows of comparatively small, rounded light spots extending from the head along each side of the back and basal half of the tail. The belly is uniformly pigmented, the throat light. The measurements are as follows: Total length 122 mm.; tail 54 mm. Length of head 17 mm.; width 14 mm.

Order SALIENTIA

Family BUFONIDAE

Bufo americanus Holbrook

North Carolina: West side Wayah Gap, Oct. 16, 1926, 1 yg.

Family HYLIDAE

Acris gryllus (LeConte)
North Carolina: Whitakers, Oct. 25, 1926, 1 ad.
South Carolina: Nichols, Oct. 21, 1926, 15 yg. and ads.

Order SQUAMATA

Suborder SAURIA

Family IGUANIDAE

Sceloporus undulatus (Latreille)

Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.; Crabtree, July 8, 1927, 1 ad., K. F. Chamberlain, coll.

Georgia: Dick's Creek Gap, Oct. 18, 1926, 2 yg.

Family SCINCIDAE

Eumeces fasciatus (Linné)
North Carolina: Maysville, Oct. 23, 1926, 1 yg.

Suborder SERPENTES

Family COLUBRIDAE

Carphophis amoena amoena (Say)

North Carolina: East side Wayah Gap, Oct. 16, 1926, 1 ad., F. N. Blanchard, det.

Diadophis punctatus punctatus (Linné)
South Carolina: Sumter, Oct. 20, 1926, 1 ad., F. B. Blanchard, det.

Diadophis punctatus edwardsii (Merrem)

North Carolina: East side Wayah Gap, Oct. 16, 1926, 10 eggs, 1 yg.; between Swain and Emma, Oct. 15, 1926, 1 ad.

Georgia: Dick's Creek Gap on line between Rabun and Towns Counties, Oct. 18, 1926, 1 ad., F. N. Blanchard, det.

The eggs found on the east side of Wayah Gap were clustered together beneath a large flat stone by the side of the road, and were hatching when discovered, two or three snakes being partly out of the shells. When exposed to the light they promptly withdrew. The eggs with the soil on which they were resting were transferred to a tight box and kept until the entire complement hatched.

Heterodon contortrix (Linné)
South Carolina: Sumter, Oct. 20, 1926, 1 yg.

Lampropeltis triangulum triangulum (Lacépéde)
Tennessee: Laurel Creek near Elkmont, Oct. 8, 1926, 1 ad.

Natrix sipedon sipedon (Linné)
Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 2 yg.

Storeria occipito-maculata (Storer)
North Carolina: Andrews, Oct. 17, 1926, 1 ad.

Thamnophis sirtalis sirtalis (Linné)
North Carolina: East side Wayah Gap, Oct. 16, 1926, 1 ad.; Big Bald Mt., Oct. 13, 1926, 1 ad., 1 yg.
Tennessee: Rough Creek near Elkmont, Oct. 8, 1926, 1 yg.

Order TESTUDINATA

Family TESTUDINIDAE

Terrapene carolina carolina (Linné)
North Carolina: Weldon, Oct. 26, 1926, 1 yg.

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EXPLANATION OF PLATES 23–26

PLATE 23

Fig. 1. *Ambystoma mabeei* n. sp. Outline drawing to show the shape, proportions and costal grooves. Actual length 100 mm.

Fig. 2. Same. Mouth parts to show the character of the tongue and teeth.

Fig. 3. *Ambystoma texanum* (Matthes). Inside of mouth.

Fig. 4. *Ambystoma opacum* (Gravenhorst). Inside of mouth.

Fig. 5. *Ambystoma talpoideum* (Holbrook). Inside of mouth.

Figures 2 to 5 are drawn to the same scale.

PLATE 24

Fig. 6. *Eurycea bislineata wilderae* Dunn. Female from Mt. LeConte, Tenn., taken Oct. 10, 1926. Actual length about 100 mm.

Fig. 7. *Plethodon metcalfi* Brimley. Frying Pan Gap, N. C., Oct. 12, 1926. Actual length 106 mm.

Fig. 8. *Plethodon shermani* Stejneger. East side Wayah Gap, N. C., Oct. 16, 1926. Actual length 130 mm.

Fig. 9. *Plethodon jordani* Blatchley. Mt. LeConte, Tenn., Oct. 9, 1926. Actual length 92 mm.

PLATE 25

Fig. 10. *Aneides aeneus* (Cope and Packard). Tallulah Falls, Ga., Oct. 18, 1926. Actual length about 35 mm. Young specimen photographed Nov. 16, 1926, to show beginning of regeneration of tail.

Fig. 11. Same specimen as in figure 10 photographed Dec. 16, 1926. Note expanded toe tips and rudimentary 1st finger and toe.

Fig. 12. Same specimen photographed Feb. 3, 1927. At the time this photograph was made, yellow pigment had appeared in small flecks on the stub.

Fig. 13. *Desmognathus fuscus carolinensis* Dunn. Natural size. A specimen which may be regarded as intermediate in character between *D. fuscus carolinensis* and *D. fuscus imitator* Dunn. Mill Creek, Mt. LeConte, Tenn., Oct. 9, 1926.

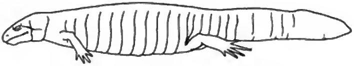
PLATE 26

Fig. 14. *Gyrinophilus danielsi* Blatchley. Near summit of Mt. LeConte, Tenn., Oct. 10, 1926. Natural size.

Fig. 15. *Desmognathus quadra-maculatus* (Holbrook). Adult, natural size from Mill Creek, Mt. LeConte, Tenn., Oct. 10, 1926.

Fig. 16. *Pseudotriton ruber schencki* Brimley. Elkmont, Tenn., Oct. 11, 1926. Natural size.

PLATE 23



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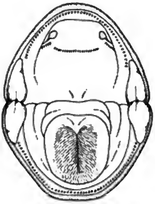

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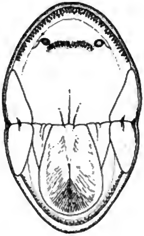

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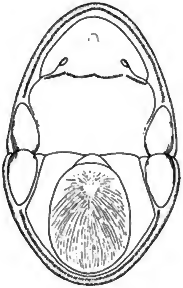

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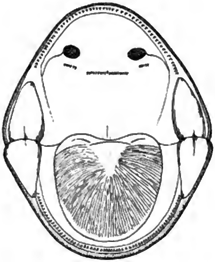

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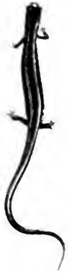
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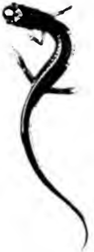
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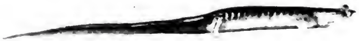
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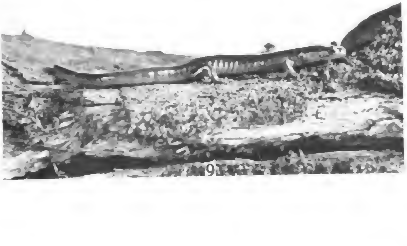
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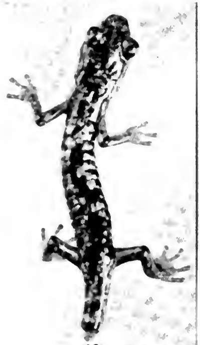
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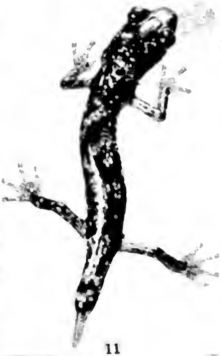
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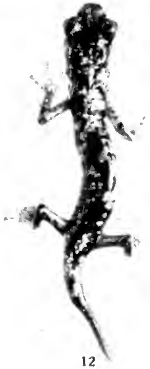
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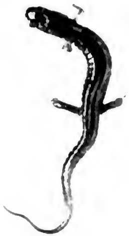
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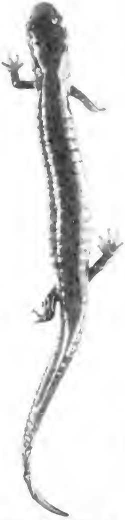
PLATE 26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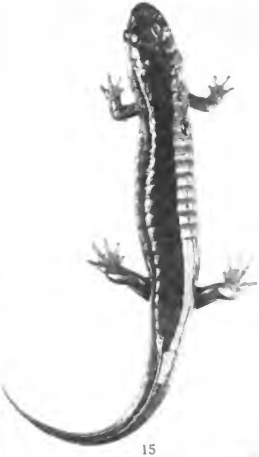
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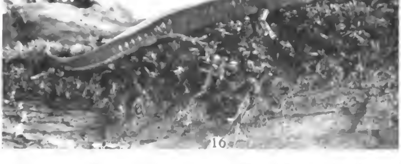
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A. H. Wright

1932, No. 1 COPEIA April 12

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The Spermatophores of *Necturus maculosus* Rafinesque

By SHERMAN C. BISHOP

EVIDENCE has accumulated over a considerable number of years that fertilization in the mudpuppy, *Necturus maculosus*, is accomplished by means of spermatophores but, so far as I am aware, these structures have not been reported.

Kingsbury, 1895, detected the presence of active spermatozoa in the spermathecae of *Necturus* collected during the fall and winter but in the absence of definite knowledge of the egg-laying period, he was unable to decide whether the sperm had been acquired during the autumnal mating period without ovulation, or had been held over after ovulation in fall or spring. Kingsbury's dissections demonstrated internal fertilization for this form and suggested the probability that it was accomplished by means of spermatophores.

Whitman, as reported by Eycleshimer, 1906, seems to have been the first to discover the eggs of *Necturus* and establish definitely an early spring egg-laying season. Eycleshimer called attention to the segregation of females during the period of egg-laying in the spring and remarked, "During the egg-laying the males are never found with the females and where they remain is unknown."

Dawson, in 1922, writes, "Strong circumstantial evidence indicates (Kingsbury, '95) that fertilization is accomplished by the deposition of spermatophores and the reception of the spermatozoa which are borne upon the summits of the deposited spermatophores into the cloaca of the female. The time and exact manner of insemination are not known."

The writer, in 1926, described the egg-laying process and mentioned the observations of Webb which indicated an autumnal courtship suggesting that of *Triturus*. It was also pointed out that, in the streams of western Pennsylvania, the males during the egg-laying season were to be found in the deeper pools of quiet water, this point having a bearing on the question raised by Eycleshimer.

Since 1926 I have had the opportunity of studying *Necturus* in several streams in western New York and would modify my earlier statement regarding the segregation of the sexes during the egg-laying period only to the extent of reporting the occurrence of males in the same kind of situations as the females, but as before mentioned, never with them in their retreats. During the mating season in the fall, however, males and females may be found beneath the same log or stone and sometimes more than a single pair in the same retreat. On one occasion two females and a male occupied the cavity beneath a large stone.

While collecting in Salmon Creek, Monroe County, New York, on October 18, 1930, several males and females were found together. The vents of the males were enflamed, strongly everted and presented to the surface many fine tubules and two strongly diverted papillae, a condition characteristic of the sex at this season. The cloacal glands were also enlarged and formed a ridge around the vent. Protruding from the vent of several females was a small, white, sac-like structure which upon examination was found packed with spermatozoa. The sperm mass resembled the apical portion of the spermatophore of *Ambystoma maculatum* except that it was more elongate, as if distorted by pressure of the vent.

The discovery of the sperm masses within the vents of the females suggested the possibility of securing the complete spermatophores if specimens were taken earlier in the season. On October 7, 1931, Salmon Creek was again visted and 14 specimens representing both sexes were collected and confined in aquaria.

Pairs were segregated as well as individuals of each sex, but in the five day interval that followed no spermatophores appeared, nor did any of the individuals confined together evidence the slightest interest in their mates.

Since it has been demonstrated a number of times that ovulation may be induced in amphibians by pituitary transplants and by injections of pituitary extract, it was believed likely that stimulation might induce the deposition of spermatophores, especially since the males were taken during the season when normal deposition might be expected to occur. Beginning October 12, three males were given daily injections of 2 cc. of alkaline aqueous extract of whole sheep's pituitary[1] and on October 15, one specimen responded by dropping two spermatophores on the floor of the aquarium. Two additional spermatophores were found the following day. On October 17, the same specimen deposited a jelly-like string containing two spermatophores and on the 18th a single perfect one. Several others appeared on October 22, 23, and 26.

A second specimen deposited a single spermatophore and a string containing two on October 11, and one additional on October 23. No spermatophores were found in the aquarium in which a male was confined with a female, but fragments of a jelly-string appeared from time to time.

Males taken at the same time and place were retained without stimulation throughout the experiment and failed to produce a spermatophore or even strings of jelly.

The spermatophore (Fig. 1-3) consists of a gelatinous basal part supporting an apical, milky-white sperm mass. These parts are enclosed within a thin tube of clear jelly which becomes more tenuous where it passes over the sperm mass and continues from either end as a slender string. The continuation of the tube at the apical end of the spermatophore is at one side. The gelatinous basal part may be oval in outline or distinctly vase-shaped and there is no suggestion of a broad base for attachment as in the spermatophores of *Ambystoma maculatum, Triturus viridescens* and others. The terminal portion containing the spermatozoa is frequently whorled in two or more turns. A characteristic feature is the presence, in the basal part, of many small hexagonal crystals, apparently carbonate of lime.

The tube-like envelope which surrounds the spermatophores and which

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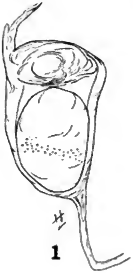
[1] Product of Parke, Davis and Co., Research Department, Detroit, Mich.



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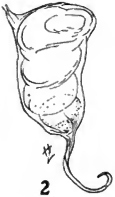

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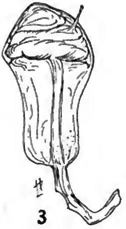

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with a small amount of enclosed jelly forms the connection between the spermatophores deposited in strings, suggests the sperm string of *Cryptobranchus.* It may also indicate that the spermatophores of *Necturus* are normally produced in strings and that when dropped singly they have simply been pinched off by the vent. The lack of a broad base for attachment also suggests the possibility of direct transference of the sperm mass to the female in a venter to venter copulation. The discovery of spermatophores of *Necturus,* deposited under natural conditions and without stimulation, will determine whether or not those described above are typical of the species.

Single spermatophores vary in length from 10 to 12 mm. and in diameter, across the widest part of the apical portion, from 6 to 8 mm.

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THE PAINTED TURTLES OF THE GENUS CHRYSEMYS

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THE PAINTED TURTLES OF THE GENUS CHRYSEMYS

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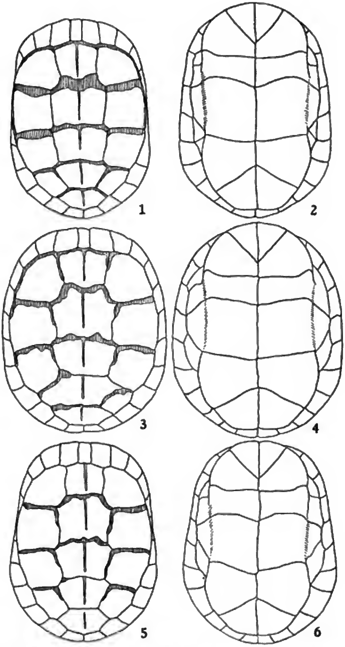
The difficulty experienced in identifying certain painted turtles from eastern New York with either *Chrysemys picta* or *C. bellii marginata* and those from the vicinity of Chicago with either *C. bellii bellii* or *C. bellii marginata*, has led the writers to examine the specimens of these forms in the collections of various institutions, including Field Museum of Natural History, University of Wisconsin, New York State Museum, College of Forestry at Syracuse University, Cornell University, Hobart College and University of Rochester. To the authorities of these institutions we are much indebted for the facilities placed at our disposal.

Certain results of this study throw light on the general taxonomic problem of intergradation between subspecies. *Chrysemys picta* and *C. marginata* have been found to intergrade in a comparatively narrow area in eastern New York where the ranges of the two forms overlap. The subspecies *marginata* and *bellii* intergrade in a rather broad area in the Chicago region. *Chrysemys treleasei* Hurter, recognized in recent lists as a subspecies of *C. bellii*, has been reduced to synonymy.

Among the turtles placed in the genus *Chrysemys*, *C. picta* has been regarded as specifically distinct, and doubtless, when typical specimens are considered, it is the most aberrant member of the group. On the other hand, *bellii*, *dorsalis*, and *treleasei* have at times been designated as subspecies of *marginata* or, more properly, *marginata*, *dorsalis*, and *treleasei* as subspecies of *bellii*. But if intergradation between closely related forms be accepted as indicating subspecific relationship, the various valid forms mentioned above must be regarded as subspecies of *picta*.

Before attempting to indicate more particularly the status of these forms, it may be pertinent to mention briefly the characters which have been proposed to distinguish them. *Chrysemys picta* was described by Schneider in 1783. It is characterized by having the dorsal plates arranged in nearly regular transverse rows and broadly margined anteriorly with yellow. The plastron is yellow and immaculate. In the other members of the genus, the costal

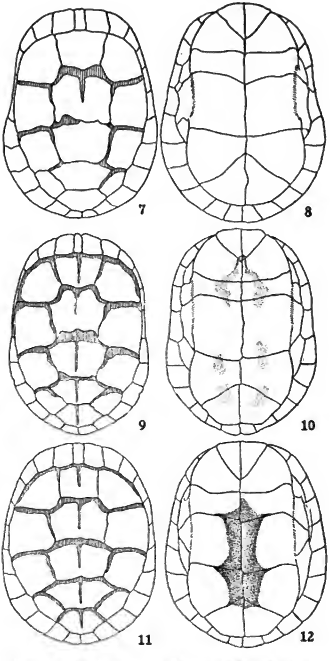


FIGS. 1–6. *Chrysemys picta picta* (Figs. 1–2) and intergrades with *Chrysemys picta marginata*.

plates alternate with those of the vertebral series and the colored margins of the plates are much narrower or absent. *Chrysemys bellii*, described by Gray in 1831, is further distinguished by the presence of net-like light lines on the carapace and by the great development of the plastral marking. In *C. marginata*, described by Agassiz in 1857, the dark ventral figure is much narrower. In *C. dorsalis*, Agassiz, 1857, there is a median dorsal light stripe conspicuously developed and the venter is usually immaculate. *Chrysemys treleasei*, described by Hurter in 1911, was distinguished by the red coloring of the plastron. It should be noted that Agassiz (1857, pp. 438–39) mentioned the occasional absence of the dark ventral figure in *marginata* and said that it was rarely developed in *picta*. Except in the case of *picta*, which has a different plate arrangement, it is obvious that color characters have been mainly relied upon to distinguish the various forms.

In an earlier paper (Bishop, 1923) attention was called to the fact that some painted turtles from eastern New York were intermediate in character between *picta* and *marginata*. Since that time many additional specimens have been collected and of these a sufficient number have been figured to indicate the character of intergradation. The drawings (Figs. 1–24) are reproduced from tracings of photographs which were subsequently bleached, and are therefore accurate.

A typical *picta* from Springfield, Massachusetts, is illustrated (Figs. 1–2, N. Y. S. M. No. 4116, ♀, 133 x 94 mm.). In a specimen (Figs. 3–4, N. Y. S. M. No. 8978, ♀, 140 x 110 mm.) from Hudson, New York, the *picta* characters predominate, but the dorsal plates are less broadly margined and there is a tendency for the costal plates to be slightly out of line with the vertebral. In the Albany, New York, specimen (Figs. 5–6, N. Y. S. M. No. 9017, ♀, 138 x 105 mm.) the dorsal plates are more narrowly or not at all margined and they are slightly out of line. In a single individual from Dunsback Ferry, Saratoga County (Figs. 7–8, N. Y. S. M. No. 9497, ♀, 150 x 112 mm.), the dorsal plates are nearly opposite as in *picta*, some broadly, others only partly margined with yellow. In all the specimens mentioned, the venter is without the dark figure. In a specimen from New Salem, New York (Figs. 9–10, N. Y. S. M. No. 3907, ♀, 161 x 114 mm.), the dorsal plates are broadly margined and intermediate in position while the plastron is provided with a faint interrupted figure. A further development of the ventral figure is to be seen in a specimen from Snyder's Lake, Rensselaer

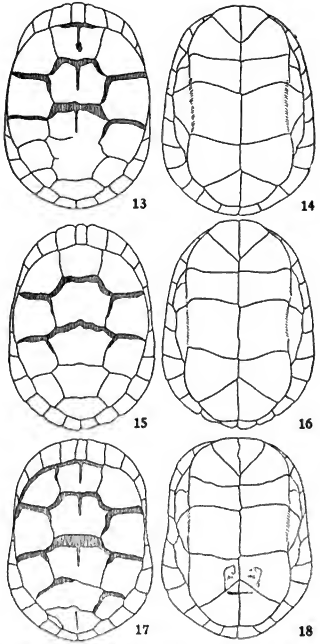


Figs. 7–12. Specimens intermediate between *Chrysemys picta picta* and *Chrysemys picta marginata*.

County (Figs. 11-12, N. Y. S. M. No. 3906, ♂, 107 x 82 mm.). The dorsal plates are here broadly margined and nearly opposite, but the venter has a bold figure fully as well developed as in many specimens of *marginata*. A turtle from Voorheesville, New York (Figs. 13-14, N. Y. S. M. No. 9273, ♀, 138 x 100 mm.) has about half the dorsal plates broadly margined but nearly alternating; the venter is immaculate. A second specimen from Albany (Figs. 15-16, N. Y. S. M. No. 8960, ♀, 130 x 94 mm.), presents almost the same condition except that the plates are more perfectly developed. The condition noted in the specimen from New Salem (Fig. 9) is almost duplicated in a turtle from Lake Maxinkuckee, Indiana (N. Y. S. M. No. 4712, ♀, 146 x 108 mm.), a region wholly outside the range of *picta*. In this specimen (Figs. 17-18) it is evident that the ventral figure is only slightly developed and the plates are intermediate in position and broadly margined. The figure is introduced to emphasize the fact that occasionally an aberrantly developed individual may be found in any part of the range of a species. The structural and color characters are again intermediate in character in a specimen from Albany (Figs. 19-20, N. Y. S. M. No. 1188, ♂, 128 x 98 mm.). A specimen from Otisco Lake (Figs. 21-22) is typical of *marginata* in every respect except that the venter lacks the dark figure (N. Y. S. M. No. 4710, ♀, 153 x 114 mm.). Typical *marginata* from Lake Maxinkuckee, Indiana, is illustrated (Figs. 23-24, N. Y. S. M. No. 4711, ♀, 134 x 95 mm.). Some Canandaigua Lake, New York, specimens, otherwise typical *marginata*, are also without the dark plastral marking.

Other intergrades not previously mentioned have been noted from Rensselaer, New York (N. Y. S. M. No. 1726); near Saratoga, New York (N. Y. S. M. No. 1951); Thacher Park, Albany County, New York (N. Y. S. M. No. 9242); and Voorheesville, New York (N. Y. S. M. No. 9273). A single specimen from Chain Bridge, Washington, D. C., which was collected by John Greeley of Cornell University (C. U. No. 1052) has the dorsal plates broadly margined, the plate arrangement intermediate and the plastron with a faint figure. Both *marginata* and *picta* were observed at this locality in the same pool, but below the bridge and within the tidal area *picta* alone was seen, while above only *marginata* was noticed.

In a series of fifty specimens from the Palisades Interstate Park, preserved in the collection of the Roosevelt Wild Life Forest Experiment Station at Syracuse University, thirteen females and nine males are intermediate in character while twenty-nine are definitely

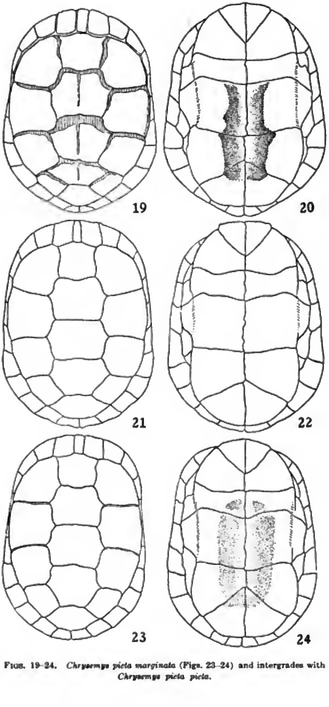


FIGS. 13–18. Specimens intermediate between *Chrysemys picta picta* and *Chrysemys picta marginata*.

picta, a condition which may indicate that in this area there has been an imperfect amalgamation, due, perhaps, to the comparatively recent invasion of *marginata* from the west. Farther to the north, the valley of the Mohawk has provided an uninterrupted waterway from central New York to the Hudson and the majority of the specimens in the vicinity of Albany are intergrades. Within recent times, the Erie canal may also have served as a means of dispersal.

Long Island, Staten Island, and other southeastern New York turtles we have examined have been typical *picta* except two from the extreme eastern end of Long Island, on which red pigment had been deposited. Only a few individuals with *marginata* characters predominating have been noticed as far east as the Hudson River, one on the East Greenbush road three miles southeast of Albany and one at Ballston Spa a few miles west of the river. All those examined from collections made in the central and western parts of the state have been typical *marginata* except as noted in the case of those aberrant individuals lacking the dark ventral figure, collected in Otisco and Canandaigua Lakes.

Basing our judgment on the material examined, we may limit roughly the area in which intergradation occurs in New York state to the valley of the Hudson as far north as Saratoga and south at least to the Palisades Interstate Park. How far the area may extend beyond these limits we have not been able to determine. *Chrysemys picta* has been recorded from Lake George and Lake Champlain but it is possible that intergrades occur in both these localities. It is also true that turtles identified as *picta* have been recorded from many localities in central and western New York, but the records are open to serious question. Thus Hall (1870, p. 19) lists *picta* from Irondequoit Bay, but the specimen itself, a skeleton, prepared at Ward's Natural Science Establishment and now in the New York State Museum, is definitely that of *marginata*. Several of the older records of *picta* were published before *marginata* had been established as a distinct species. De Kay (1842, p. 12) remarked that *picta* was to be found in every part of the state, his account antedating the description of *marginata* by fifteen years. Specimens from Fish Creek, St. Lawrence County, recorded by Hough (1852, p. 23) as *picta*, were also doubtless *marginata*. Eckel and Paulmier (1903, p. 394) lacking De Kay's justification for his belief, perpetuated his error with their statement that *picta* is "Very common throughout the state . . . ." Other doubtful records are those of Britcher (1903, p. 122), who identified as *picta* turtles from Tully, Otisco,



FIGS. 19–24. *Chrysemys picta marginata* (Figs. 23–24) and intergrades with *Chrysemys picta picta*.

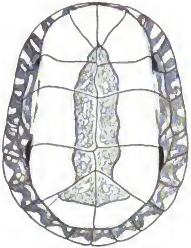
Seneca River and Dewitt, Onondaga County. We have examined a long series from this general region in the Roosevelt Wild Life Forest Experiment Station collection and have not found *picta* represented. The specimen from Axton, Franklin County, mentioned by Evermann (1918, p. 50) as *picta* is preserved in the National Museum (N. M. No. 33854). It is a recently hatched individual with six instead of five vertebral plates, an arrangement which disturbs the true alignment. The venter, however, has a dark figure and we would regard the specimen simply as an abnormal *marginata*. We have examined the specimen through the courtesy of Miss Doris Cochran of the Division of Reptiles, United States National Museum.

As noted, *marginata* and the more western *bellii* differ in a conspicuous color character, the extent of black plastral marking. In *bellii* this is nearly as wide as the plastron and sends out arms along the sutures between the various horny plates (Fig. 27). In *marginata* the black marking is narrower, and does not have the conspicuous projections of the western form (Fig. 25). These contrasted characters are figured, with an intermediate specimen from the Chicago area for comparison (Fig. 26). There do not seem to be any structural characters associated with this difference in coloration. This in itself has some bearing on theoretical taxonomy, for Amaral (1929, p. 86) has objected to the establishment of herpetological subspecies on color characters. In the present case a color pattern character affords an adequate distinction between subspecies which have been widely recognized.

The specimens available for study of the *bellii-marginata* problem fall into three groups: (1) pure *bellii*, from west of the Mississippi and from northwestern Wisconsin; (2) pure *marginata* from Indiana, southern Michigan, southeastern Illinois, Ohio, western Pennsylvania, and western New York; and (3) a highly variable, intermediate series from southeastern Wisconsin as far north as Oconto County, northern Illinois north of Chicago, and western Illinois as far south as the mouth of the Illinois River.

In the pure *bellii*, the greatest width of the black marking exceeds at least 55 per cent of the width of the plastron (the distance between the lateral edges of the abdominal plates) in all of the specimens examined, and it exceeds 70 per cent of all the plastral width in thirty-nine of the forty-four specimens, averaging 74 per cent, and ranging from 85 per cent to 56 per cent.

In fifty-one specimens from western New York, Pennsylvania, Ohio, Michigan, Indiana, and southeastern Illinois, the proportion



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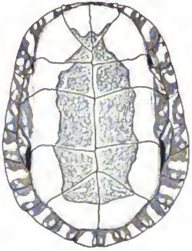

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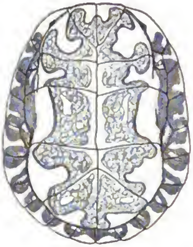

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FIG. 25. Typical *marginata* from Mineral Springs, Porter County, Indiana. F. M. N. H. 3318.

FIG. 26. A specimen from the area intermediate in character between *marginata* and *bellii*. Naperville, Dupage County, Illinois. F. M. N. H. 7453.

FIG. 27. Typical *bellii* from Black River, below Neillsville, Clark County, Wisconsin. F. M. N. H. 14707.

of the width of the black marking to that of the plastron ranges from .13 to .67, averaging only .36. While there is a considerable overlapping of the higher figure for *marginata* with the lower for *bellii*, the number of specimens which are thus outside the normal figures is small in each case. Only one of the fifty-one *marginata* exceeds .55 in this proportion, and only seven exceed .50, while only five of the forty-four *bellii* fall below .70.

The population of painted turtles in the intermediate area, examined with reference to the average width of the black markings, is exactly intermediate between the average figures determined above; eighty-two specimens yield an average figure of .55, .19 below that of pure *bellii*, and .19 above that of pure *marginata*. The range of variation, in this intermediate population, .15 to .78, corresponds nearly to the whole range for both subspecies. The intermediate population accordingly intergrades with the adjacent purer stocks both by overlap of the numerical value of the distinguishing character with an intermediate average value, and by the existence of a high proportion of specimens in which the actual width is intermediate between the normal values for the two recognized subspecies. These eighty-two specimens range in locality from Oconto County, Madison, and the Mississippi River below Prairie du Chien in Wisconsin, to Cook County, the whole length of the Illinois River, and Madison, Monroe, and St. Clair Counties, in Illinois, that is, the whole of southeastern Wisconsin, and northern and southwestern Illinois. Pearse (1923, p. 145), has already called attention to the intermediate nature of the painted turtle population at Madison, Wisconsin. Broad as it is, the area of intergradation is still relatively narrow in relation to that of the purer populations of *bellii* and *marginata*.

The identification of individual specimens from this area has naturally been a matter of great uncertainty and difficulty, since some have wide, some narrow, and some intermediate markings. If the extremes be assigned respectively to *bellii* and *marginata*, the identification of those with a moderately wide marking is not simplified, for the question as to what limiting value should be placed on this character is plainly dependent for answer on an average value for a series of specimens. Furthermore, the average rises to the westward and diminishes to the eastward, within the belt of intergradation as above determined. Specimens from the intermediate area may best be designated as "Intergrades between *bellii* and *marginata*." They should not be divided up between the two subspecies as has recently been done by Pope and Dickinson (1928), and by Cahn (1929).

The taxonomic relations indicated are evidently those of a typical pair of subspecies, geographic forms which intergrade along their boundary. The breadth of the area of intergradation in the present case is apparently due to the absence of physical barriers of any effectiveness between the two subspecies. It is not impossible that the two forms have differentiated while isolated during the last advance of glaciation, and that their intergradation is due to intermingling and hybridization in their meeting ground on their subsequent reoccupation of the glaciated territory. Genetic experiments both with pure stocks and with stock from the area of intergradation would throw light on this question.

Burt (1928) has considered a somewhat similar problem in the case of the collared lizards, *Crotaphytus collaris collaris* and *C. c. baileyi*. He finds that the western population of this species differs from the eastern in a character of the head scales, with a reciprocal overlap in the figures for the character employed of 22 per cent and 19 per cent. The amount of this overlap would be very greatly reduced if the intermediate population, in Texas and New Mexico, were separately considered. While his conclusion that it is not useful to maintain *C. c. baileyi* as a distinct form may be justifiable, the geographic relations indicated by his study seem to present an interesting illustration of an extreme case of inter-subspecific intergradation, in which the area of intergradation is actually wider than that of the uniform populations of the two subspecies themselves. This condition may well indicate an early stage in the formation of subspecies; but there is the alternative possibility that it is due to the reamalgamation of two formerly distinct forms. In either case, the comparability of the *collaris-baileyi* problem in *Crotaphytus* with that presented by the subspecies of *Chrysemys* is evident. These several pairs of subspecies therefore indicate that the subspecific category includes a continuous graded series of possible types of intergradation, from species which intergrade on a narrow boundary to forms in which the pure stock is confined to opposite borders of the total range, the area of intergradation occupying the greater part of the intermediate area.

Chrysemys treleasei, described by Hurter from specimens collected in Madison, Monroe, and St. Clair Counties, Illinois (opposite St. Louis), was distinguished, in the original diagnosis, by the red coloration of the plastron. Specimens from Monroe and St. Clair

Counties in Field Museum have red plastrons, but attentive examination shows that this is due to a superficial deposit of a red pigment (doubtless an oxide of iron). Further examination of specimens of *Chrysemys* from widely scattered localities proves that such a deposit of red pigment may take place wherever this pigment is present in the water in sufficient quantity. A few such specimens, in illustration of this fact, are described below.

F. M. N. H. No. 5937. Dune Park, Indiana. Entire shell covered with a closely adherent red deposit, more evident on the plastron, where the ground color is lighter.

F. M. N. H. No. 2852. Miller, Indiana. Red pigment on the plastron, worn off on the lateral edges.

F. M. N. H. No. 2669. St. Clair County, Illinois. Entire shell covered with red pigment, which has been worn off on the plastron except for the gular, humeral, and anal plates, and for the grooves of the growth rings on the remaining plates.

F. M. N. H. No. 14706. Clark County, Wisconsin. Red deposit on both ends of the plastron and on the carapace. In this dried shell the deposit has cracked and may easily be rubbed off.

In the specimens figured by Hurter as typical of *treleasei* (Hurter, 1911, Pl. 24) the red deposit on the plastron may be seen to be worn off along the edges of the horny plates, while it is retained in the grooves of the growth rings, where it is protected against friction during locomotion. In his description (*ibid.*, p. 235–36) he says, "In the young of the first year the red plastron is divided into squarish fields by the proportionately wide yellow sutures." This coloration is shown (Pl. 23, Fig. 3). The yellow sutures are obviously the new growth of horny shield, on which red pigment has not yet been deposited, while the squarish red fields are the primary plates (that is, the horny plates of the first year's growth), which have not yet been shed. This same figure shows that the primary right anal plate has been shed, and hence there is no red on this plate. It seems perfectly evident that the red color of the specimens on which *treleasei* was based is due to this inorganic and superficial deposit of red pigment. A similar superficial deposit of red pigment is mentioned by K. P. Schmidt as occurring on two species of Chinese turtles, *Clemmys mutica* and *Cyclemys trifasciata* (Schmidt, 1927, pp. 405–6).

Although Hurter's specimens were evidently covered with a superficial deposit of inorganic red pigment, organic red pigment commonly occurs in specimens of *bellii*, somewhat more frequently in juvenile examples than in adults. The organic red pigment differs from the inorganic in that it is not superficial, but is found in the Malpighian layer of the skin (the layer next to the bone). About half the living specimens examined from Madison, Wisconsin, had red plastrons, with organic red pigment as described above. These are intergrades between *marginata* and *bellii*. Five out of six specimens of *bellii* from Clark County, Wisconsin, had the plastron red in life. A juvenile specimen from Miller, Indiana (typical *marginata*), had the plastron coral red (Ridgway). Thus the painted turtles with a red plastron do not seem to have any relation to geographic range, and do not form a subspecies. It may also be noted that the organic red pigment of the plastron turns yellow in alcohol, while specimens with superficial inorganic red pigment remain unchanged.

Although we have tentatively included the area assigned by Hurter to *Chrysemys treleasei* in the area of intergradation between *bellii* and *marginata*, there is a distinct approach to *bellii* in the series from lower Illinois River, Monroe County, and St. Clair County, Illinois. In order to simplify the synonymy, we accordingly propose that *C. treleasei* be placed under *bellii*. The changes from the nomenclature of the "Check List of North American Amphibians and Reptiles" (Stejneger and Barbour, 1923) involved in this arrangement and in the recognition of intergrades between *picta* and *marginata* are indicated below.

Chrysemys picta picta (Schneider).

Testudo picta Schneider, Naturg. Schildkr., p. 348, 1783.
Chrysemys picta Gray, Cat. Shield Rept. Brit. Mus., pt. 1, p. 32 (part), 1856.

Chrysemys picta bellii (Gray).

Emys bellii Gray, Syn. Rept., p. 31, 1831.
Chrysemys marginata bellii, Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.
Chrysemys bellii bellii Ruthven, Sci., 59, p. 340, 1924.
Chrysemys treleasei Hurter, Trans. Acad. Sci. St. Louis, **20**, p. 235, pl. 23, fig. 3; pl. 24, 1911.

Chrysemys picta marginata (Agassiz).

Chrysemys marginata Agassiz, Contr. Nat. Hist. U. S., **1**, pt. 2, p. 439; **2**, pl. 1, fig. 6, pl. 5, figs. 1-4, 1857.
Chrysemys marginata marginata Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.
Chrysemys bellii marginata Ruthven, Sci., 59, p. 340, 1924.

Chrysemys picta dorsalis (Agassiz).

Chrysemys dorsalis Agassiz, Contr. Nat. Hist. U. S., **1**, pt. 2, p. 440, 1857.
Chrysemys marginata dorsalis Stejneger and Barbour, Check List N. Amer. Amph. and Rept., (1), p. 118, 1917.

The range of *Chrysemys picta bellii* extends from the Rocky Mountains to the Mississippi River, southward to New Mexico and Texas, presumably intergrading with *C. picta dorsalis* somewhere in Louisiana, Arkansas, and Texas, westward to the Pacific coast in Washington and British Columbia, and eastward through northwestern and northern Wisconsin, upper Michigan (Ruthven, Thompson, and Gaige, 1928, p. 159) and the Lake Superior drainage of the province of Ontario (Logier, 1928, pp. 290–91). This extension of what is in the main a plains species through the heavily forested area of Wisconsin, Michigan and Ontario seems explainable in part by the highway for dispersal supplied by the valley of the St. Croix and by Lake Superior itself.

The range of *Chrysemys picta marginata* extends from eastern New York through western New York and western Pennsylvania, Ohio, Indiana, and the lower peninsula of Michigan and southeastern Illinois, intergrading with *C. picta bellii* in Illinois and Wisconsin, and presumably with *C. picta dorsalis* somewhere to the south of the Ohio River, the southeastern border of its range being ill defined.

It is unfortunate that nomenclature does not indicate more perfectly actual relationships. It is probable that *picta* is an eastern and *bellii* a western derivative of *marginata*. *Chrysemys dorsalis* may more easily be derived from *marginata* through the loss of the ventral figure than from *bellii* (whose range it also touches), in which the development of the plastral marking is much more greatly emphasized.

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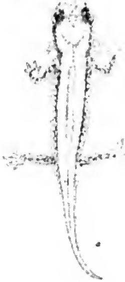
The Nests and Young of the Allegheny Salamander *Desmognathus fuscus ochrophaeus* (Cope)

By Sherman C. Bishop and Hugh P. Chrisp

THE Allegheny salamander is widely distributed and common in many parts of its range but very little has been published concerning its habits and development. Dunn in 1926 was able to summarize in a few lines practically all that had been made known and since the publication of his report very little has been added.

The eggs of this species were reported by one of us (Bishop, 1925: 11) from Troy, Bradford County, Pa. They were found in a shallow excavation beneath a log on a springy hillside August 2, 1924, while on a collecting trip with A. H. Wright. The fourteen eggs were disposed in a mass and attended by a female. Individual eggs were small as was the female found with them. Brief field notes made at the time were as follows: "The eggs



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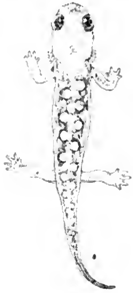

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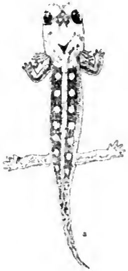

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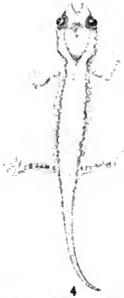

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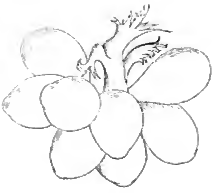

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Fig. 1.—*Desmognathus fuscus ochrophaeus* Cope. Recently hatched larva from Tufa Glen, Rochester, N. Y., March 12, 1933. ×4.2.

Fig. 2.—*Desmognathus fuscus carolinensis* Dunn. Larva from Mt. Mitchill, N. Carolina. October 21, 1923. ×4.2.

Fig. 3.—*Desmognathus fuscus fuscus* Raf. Larva from Conneaute Lake, Pa. Aug. 25, 1925. Often the paired spots form a zig-zag line much as in *D. f. carolinensis*. ×4.2.

Fig. 4.—*Desmognathus fuscus ochrophaeus* Cope. Young just transformed. ×4.2. At transformation, the snout is conspicuously light colored.

Fig. 5.—Empty egg capsules of *D. f. ochrophaeus* Cope.

in the cluster are not brought together at a common focus, as is frequently the case with the eggs of *D. fuscus fuscus,* but several adjacent eggs are united by extensions of the outer envelopes which are more or less pear-shaped."

The eggs were not carried through and for a time some doubt was entertained as to their proper identity. On March 12, 1933, fourteen recently hatched larvae were found in a little cavity beneath the corner of a large flat stone by the side of a small spring, in Tufa Glen near Rochester, New York. Eleven of the young were grouped in a compact mass and three additional larvae and some empty egg capsules were clinging to the lower surface of the stone where it covered the nest. Three adults were beneath the same stone but not at the nest. The soil on which the stone rested was sandy with the addition of considerable vegetable debris; it was thoroughly wet from the trickle of the spring above.

On March 17 we searched the springy hill-side of Corbett's Glen near Rochester and on this date Mr. Richard Hart rolled over a stone partially imbedded in the sandy hillside and exposed another group of young, five of which were collected.

The following day, March 18, a nest containing 14 young was found in a small cavity on the lower side of a rotting log which lay in the saturated soil of a springy slope. Essentially the same type of nest site was chosen in each instance and the eggs were so placed that they received abundant moisture from the water that seeped through the soil beneath.

In the case of the first lot discovered, little significance was attached to the finding of three larvae and empty egg envelopes clinging to the lower surface of the stone but with the recovery of the egg envelopes and young in the cavity of the log, it was evident that the mass had been attached. The large amount of yolk retained by the larvae and the perfect condition of the envelopes, indicated recent hatching.

Unlike the eggs of *Desmognathus fuscus fuscus,* the envelopes of *D. f. ochrophaeus* are not usually drawn together at a common focus but are attached by short extensions of the outer layer to a common stalk, like a bunch of grapes. In this respect they resemble some of the egg masses of *D. f. carolinensis* mentioned by Pope (1924: 4). The empty envelopes were definitely elongated and several had a bulbous protuberance at the free end.

The newly hatched larvae are easily distinguished from those of the dusky salamander and from *D. f. carolinensis.* The general ground color of the sides, the legs and the venter is dull white; that of the back dull yellow tinged with pinkish. The snout above is mottled with pigmented areas and small light spots. From the eyes a median light area is continued backward, abruptly widening behind the eyes to nearly the full width of the head. Just above the gills it contracts and continues along the midline of the trunk as a broad band with nearly straight edges. The dorsal light band lacks the conspicuous dark-bordered light spots so characteristic of *D. fuscus fuscus, D. f. carolinensis* and *D. phoca.* The band is, however, flecked with scattered chromatophores slightly concentrated to form a Y-shaped mark on the head between the gills, and an irregular spot between and in front of the eyes. The dorsal band is limited on each side by a darker band which originates on the snout in front of the eye, passes through and below the eye and continues on the side of the head and along the sides of the trunk and tail. The lateral band is darkest along its upper margin where the chromatophores are strongly concentrated in a rather narrow strip next to the light median band. The lower sides are mottled with pigment-free areas of irregular shape and size. The ventral surface of the head, tail and legs is dull white with only a few scattered chromatophores along the margin of the lower jaw and on the tail near its tip. The belly is bright yellow, colored by the yolk. The average length of ten specimens is 17.85 mm.

The length of the period the gills are retained is apparently determined largely by the amount of moisture present and, to some extent, by the temperature. Larvae taken March 12 had well developed but short gills free from pigment. On March 16 the gills on some individuals had shortened to half their length and remained in this condition through March 20. On March 24 all but one of ten specimens kept alive had reduced the gills about one half. March 28, nine of the ten specimens still retained very short gill rudiments and one had lost the gills entirely. On April 1 all but one had lost the gills, the single individual retaining rudiments until April 7. This lot of specimens was kept among saturated leaves in a glass jar under cold running water.

Larvae collected March 18 were kept among damp leaves at room temperature of 68 to 70° F. On March 24, nine of the ten specimens kept alive had lost the gills entirely and had undergone a conspicuous color change. The single specimen which retained the gills a few days longer also kept its larval pattern. It is evident, therefore, that the gills may be lost in a few days after hatching or retained for several weeks.

The average length at transformation is 18 mm. The superficial black chromatophores on the snout which give a mottled appearance to the larva largely disappear at transformation, leaving the whole fore part of the head conspicuously light. The mottling of the sides is also largely lost in the generally darker color of the sides below the dorsal band. In a few individuals there is a very slight development of large, round, light spots within the dorsal band.

Since eggs had been found in August and recently hatched larvae in March, we were led to assume that these dates might approximately mark the limits of the egg-laying season plus the period of incubation.

After the foregoing paragraphs had been written we received from Mr. Jay A. Weber of Leonia, N.J., an interesting account of his independent and earlier discovery of the recently hatched young and with his permission the following notes are added.

On September 26, 1932, Mr. Weber found a colony of these salamanders among layers of shale in a drying spring draining into Woodcock Creek in northwestern Pennsylvania. Many sets of eggs were found attached to the under sides of flat rocks in the spring bed. Most of the eggs were attached at one central point and their stalks twisted around one another. The form of the eggs was distinctly elliptical as though shaped by their close attachment and pressure of the embryo. The elliptical shape was retained, however, by the egg capsule after hatching. One clutch of eggs was laid in sets of three pairs and six singly attached, twelve in all. In another clutch six eggs were attached at a central point with their stalks twisted into a single rope-like strand and the balance attached singly. One mass of twelve eggs was found. When deposited singly, the eggs were almost spherical.

Mr. Weber's observations on the shape of the egg-envelopes, the disposition of the eggs and the number are in close agreement with ours. The discovery of the hatching young in September and again in March raises the question whether we are dealing with a form having an extended breeding season or with one which under slightly different conditions has breeding seasons at distinct periods of the year. The fact that young were found hatching in considerable numbers both in September and March might be taken to indicate that the latter conjecture is the correct one; but the problem is further complicated by the discovery that a few females taken with the newly hatched larvae had large and well developed eggs in the ovaries. On May 12,1933, a single female among several collected at Glen Edith, West Webster, N. Y., by Arlene Thurston and Helen Snearing, was found to have the cap of a spermatophore held in the vent. The mass was small and compact and packed with active sperm.

SUMMARY

1. The larva of *Desmognathus f. ochrophaeus* is quite distinct from that of other species of the genus and easily recognized because of the absence of paired spots within the dorsal light band.
2. The larvae transform at a length of about 18 mm. without entering water. If placed in water they attempt to crawl out.
3. The gills may be retained for several weeks or lost in a few days, depending on the amount of moisture present and possibly, to some extent, on temperature.
4. The freshly laid eggs have been found in August and recently hatched larvae in September and March.
5. Twelve to fourteen eggs have been found to be deposited by a single female and they may be attached singly, in pairs, or in clusters containing as many as fourteen, to some covering object.
6. Fertilization is apparently accomplished by means of spermatophores, a sperm mass having been found in the vent of a female taken May 12, 1933.

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DEPARTMENT OF BIOLOGY, UNIVERSITY OF ROCHESTER, ROCHESTER, NEW YORK.

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PROCEEDINGS

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DESCRIPTION OF A NEW SALAMANDER FROM OREGON, WITH NOTES ON RELATED SPECIES.

BY SHERMAN C. BISHOP.

Among some salamanders recently received alive from Oregon are six adults of a large Plethodon quite distinct from any described species. The specimens came from Eagle creek, Clackamas County, near Portland, and from a locality just outside the city limits of Portland itself. The same general region also supplied several individuals of *Ambystoma gracile*, *Ensatina eschscholtzi* and the Plethodon which has been known as *P. intermedius* Baird.

Plethodon dunni, n. sp.

Description.—This is a rather long and slender species with the head only moderately broad in the female but distinctly widened above the angle of the jaws in the male. The eyes are large and prominent with the iris tinged with brassy. In five specimens, the costal grooves are 15, counting one each in the axilla and groin. In one there are 14 on one side and 15 on the other. The groove immediately anterior to the groin is incompletely developed in all specimens and sometimes joins the one in the groin. If this one is left out of consideration, the count is 14. There are 3-3¾ intercostal spaces between the appressed toes.

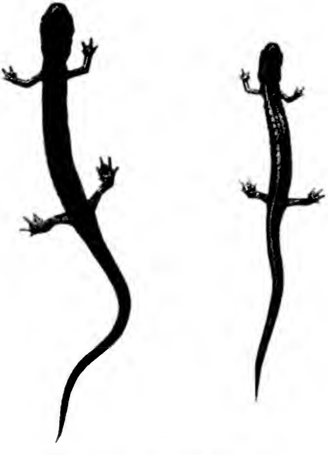
The vomerine series is long in the female, the teeth varying in number from 8 to 13. The series originate behind the middle of the inner nares and curve inward and backward, separated posteriorly and from the parasphenoid patches by a distance about equal to the diameter of a naris. In the type, the vomerine teeth of the left side are nearly or quite continuous with the parasphenoids; in the other specimens they are distinctly, though narrowly separated. In the male the vomerine teeth are fewer in number, 6 to 8 in each series.

In life, the ground color of the upper sides is deep brown fading to pale slate toward the belly. The broad dorsal band is dull tan with tinges of greenish and flecked with black or dark brown spots of irregular size and shape. The sides are distinctly mottled with small, irregular, white and tan markings. There are fewer dark markings within the dorsal band on the tail so that the color is brighter in this region, dull yellow with greenish tints. The legs are mottled and the head above is quite uniformly dull brownish yellow. The throat, belly and lower surface of the tail and limbs are slate color flecked with many small pale spots. In one specimen, the dorsal band is quite dark and there is evident a tendency toward melanism.

In alcohol, the ground color of the sides becomes dark brown or slate and the dorsal band fades to dull tan or dirty white.

MEASUREMENTS.

Locality	*Date*	*Sex*	*Length in mm.*				*Vomerine teeth*	*Costal folds between toes*
			Total	*Snout to vent*	*Head*	*Tail*		
Portland, Ore.	Dec. 23, 1933	♀	130	65.5	13.5	64.5	right 9; left 13	3
" "	Jan. 13, 1934	♀	131	66.5	14	64.5	right 9; left 12	3–½
Eagle creek near Estacada, Clackamas Co., Oregon	Jan. 27, 1934	♀	124.5	59.5	13	65	right 8; left 10	3–½
" "	"	♂	98	51	12	tip lost	series imperfect	3–¾
" "	"	♂	120	61	14	59	6–6	3–½
" "	"	♂	103	59	13	—	8–8	3–½



1. *Plethodon dunni*, n. sp. Adult male, natural size.
2. *Plethodon vehiculus* Cooper (*intermedius* Baird).

Type.—An adult female, 131 mm. long collected by Stanley G. Jewett, Jr.

Type locality.—Just outside the city limits of Portland, Oregon in Clackamas county, January 13, 1934. Type in the U. S. National Museum.

Remarks.—While studying type material at the National Museum, I was fortunate to encounter Dr. E. R. Dunn who called my attention to the figure of *Ambystoma vehiculum* Cooper, from Astoria, Oregon, in volume 12 of the Pacific R. R. Survey report for 1860.[1] Dunn suggested that the name might be available for the species from Portland. An examination of the figure, however, and reference to Dr. Dunn's notes revealed that the species long known as *Plethodon intermedius* Baird[2] is, in fact, the species figured by Cooper and should be known as *Plethodon vehiculus*.

J. G. Cooper, attached to the survey as collector, reported on the "reptiles" and among several other salamanders, figured *Ambystoma vehiculum*. (Plate 31, fig. 4.). Following the legend of plate 31 is the parenthetical note, "(not yet published)." This note evidently refers to the salamanders figured, accounts of which were to have appeared at some later date. The series of survey reports closed with volume 12 and apparently nothing more was published. The figure is an excellent one and leaves no doubt as to the identity of the species.

Plethodon dunni is evidently related to *Plethodon vehiculus* and has a similar costal groove count. It is easily distinguished by its larger size, distinctly different color, greater number of vomerine teeth, more compressed tail, more strongly mottled sides and the marked sexual dimorphism in a widened head and short vomerine series of the male. It differs from *P. elongatus* in its lower costal groove count, in body proportions, and color.

The species is named in honor of Dr. E. R. Dunn whose careful studies of salamanders have been so useful to all herpetologists.

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[1] Cooper, J. G. Reports of the Explorations and Surveys from the Mississippi River to the Pacific Ocean. 12(2) rept. 4:292-306, pl. 31, fig. 4.

[2] Baird, S. F. Proc. Acad. Nat. Sci. Phila. 1867, p. 209.

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A NEW NEOTENIC SALAMANDER FROM TEXAS.[1]

BY S. C. BISHOP AND MARGARET R. WRIGHT.

On April 1, 1936, we collected in a small stream five miles north of Helotes, Texas, and took nine larval salamanders from among dead leaves in the deeper pools. These salamanders obviously belong in the genus Eurycea and in body form, color and pattern resemble *E. b. bislineata*. From *bislineata* they differ in having 16 costal grooves, and poorly developed dorsal light bands and dorso-lateral light areas. Although the gills are well developed in all individuals, and the tail, tongue, dentition and cranial characters are larval in character, the larger individuals of both sexes are sexually mature.

The structural features of generic significance which, in adults, easily separate Eurycea and Typhlotriton, are not sufficiently developed in the larvae to serve as criteria. However, the larvae from Texas may be distinguished from those of Typhlotriton by their color, pattern, smaller size, different costal groove count and shape of the tail fins. Typhlotriton larvae are more uniformly colored and attain a length of at least 97 mm. while the largest sexually mature male of the Texas salamander is only 72 mm., and the largest female, 69 mm. The costal grooves of Typhlotriton are 17 in the majority of specimens, counting one each in the axilla and groin, while in the Texas material the count is usually 16, but varies from 15 to 17. The tail fins of Typhlotriton are broad and the tip of the tail bluntly pointed; in the Eurycea here described, the fins are narrow and the tail tapers to a sharp point.

The genus Eurycea in Texas has heretofore been represented by *Eurycea* (*Manculus*) *q. quadridigitata* in the eastern part of the State and *Eurycea melanopleura* from an unknown locality. The former has only four toes and the latter 13 costal grooves. The characteristics given below will distinguish the new Texas species from other members of the genus Eurycea.

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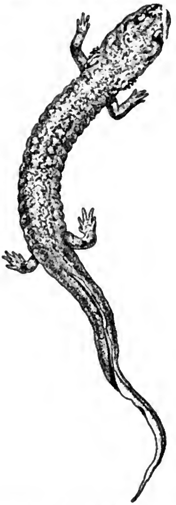
[1] Contribution from the Department of Zoology, University of Rochester.

Eurycea neotenes, sp. nov.

This is a small, slender species attaining a maximum length, in this series of specimens, of 72 mm. Head moderately broad, widest immediately anterior to the gills; snout bluntly rounded; gills with long rami; costal



Eurycea neotemes, n. sp. Male, actual length 72 mm.
Drawn by Miss M. L. Leffler.

grooves 15–17; tail oval in section near base, somewhat flattened below, compressed distally; dorsal tail fin very narrow and extending from a point dorsal to the posterior end of vent to a sharp point at the tip of the tail; ventral tail fin equally narrow and extending less than half the length of the tail, continued a short distance further as a low ridge; toes 4–5, free; toes of fore feet in order of length, from the shortest, 1, 4, 2, 3; hind, 1, 5, 2, 4, 3. Vent of female a simple slit with a few low tubercles along the margins; that of the male with the margins thrown into folds.

In life the ground color is yellowish with the brown chromatophores aggregated on the back and sides to give a mottled appearance. There is only a slight indication of a light dorsal band, and the light dorso-lateral spots are only faintly developed. The secondary row of light larval areas is developed only on the smaller specimens. The sides of head and chin are lightly pigmented, and the dark line from eye to nostril is more prominently developed than in *E. b. bislineata.* The lower sides and belly are without pigment.

Holotype, male, 68 mm. long; allotype, female, 62 mm. long. Types deposited in the U. S. National Museum.

Type locality.—Culebra Creek, 5 miles north of Helotes, Bexar County, Texas. April 1, 1936. Nine specimens of both sexes.

Field notes.—The stream where the larvae were taken flows over bed rock at the foot of a wooded ridge. At the time of our visit, the water was shallow except in small pools which had a depth of 12–18 inches. The surrounding territory was exceedingly dry, and search along the borders of the stream and beneath logs and stones on the adjacent hillside failed to discover transformed individuals of this or any other salamander. It remains to be discovered if this salamander ever transforms.

Measurements and costal grooves are indicated below for the nine specimens.

	LENGTH IN MM.		COSTAL GROOVES	
SEX	TOTAL	TAIL	LEFT	RIGHT
male	68	32	16	16
male	72	33	16	16
male	66	31	16	15
male	53	24	16	16
female	62	29	15	16
female	69	32	17	16
female	68	31	16	16
female	61	27	16	15
young	39	16	15	15

The specimens upon which the above account is based were collected during a field trip made possible by a grant from the National Research Council.

Reprinted from COPEIA, 1941, No. 1, March 25

Herpetological Notes

NEW LOCALITY FOR *SCELOPORUS UNDULATUS UNDULATUS*.—The range of the eastern fence lizard, *Sceloporus undulatus undulatus* (Latreille), is from southeasterly New York state to Florida. It is commonly found in the Pine Barrens of southern New Jersey, but in the extreme northern portion of its range, in the vicinity of the Hudson River Valley, it is considered rare.

The presence of *Sceloporus u. undulatus* in New York was rediscovered by Hassler (COPEIA, 163, 1927: 48–50). While visiting the Bear Mountain Trailside Museum, Bear Mountain, New York, September 7, 1939, the writer was informed by Mr. William H. Carr, Director of the Museum, that seven *S. u. undulatus* had been collected by Mr. Schwarting in what is believed to be a new locality. On July 14, 1939, Schwarting ascended Anthony's Nose, which is situated one-fourth of a mile south of the Putnam-Westchester County line, rising directly above the Hudson. This location is about 14 miles south of Breakneck Ridge where Hassler collected *S. u. undulatus* in 1926. Schwarting found his specimens at the very summit of Anthony's Nose, 900 feet altitude. It is interesting to note that both Hassler's and Schwarting's swifts were taken at a considerable altitude.

All Schwarting's specimens are adults. One male measuring 156 mm. was presented to the Peabody Museum at Yale University.—MARSHALL B. BISHOP, *Peabody Museum of Natural History, New Haven, Connecticut.*

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NOTES ON SALAMANDERS WITH DESCRIPTIONS OF SEVERAL NEW FORMS

BY SHERMAN C. BISHOP*

WHILE preparing the manuscript for a handbook of the salamanders of the United States and Canada, several new species and subspecies have been found and some notes accumulated which should appear in advance of the publication of that work. In the nomenclature of the handbook it is proposed to follow the Stejneger and Barbour *Check List*, except as additional information concerning certain species makes it advisable to depart from that standard.

Three subspecies of *Triturus viridescens* are currently recognized from South Carolina, *viridescens* from the mountains and Piedmont and *louisianensis* and *symmetrica* from the coastal plain. The name *symmetrica* has been applied at times to all three forms, early writers used it to designate the newt which is now recognized as typical *viridescens*, Schmidt (1924: 67), to indicate a southeastern newt having no black rings about the faint dorsal spots (*louisianensis*); the third and fourth editions of the *Check List* and other authors apply it to the newt of the Southeast having interrupted black-bordered dorsolateral red stripes. I have long been of the opinion that *symmetrica* is a synonym of *T. v. viridescens.*

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In Harlan's original description of *Salamandra symmetrica* (1825: 157) there is no mention of stripes, but there is a specific note of "a row of deep orange-coloured spots on each side of the spine, symmetrically arranged." A little farther along in the same account, the spots are even more specifically described as "a row of deep orange-coloured oval spots, nine or ten in number, lining each side of the spine." From this description it is evident that *symmetrica* should not be applied either to Wolterstorff's newt, *louisianensis,* or to the broken-stripe newt from the Atlantic coastal plain. In the original description, the locality for *symmetrica* was given simply as: "Inhabits South Carolina. Presented by Dr. Blanding," but the introduction to Harlan's paper makes it clear that the specimens came from the vicinity of Camden, Blanding's home.

In 1829 Harlan (1829: 101) described *Salamandra dorsalis,* also from the vicinity of Camden. This obviously refers to a species with elongate spots or broken stripes, for it was described as having "a row of whitish coloured oblong spots on each side of the dorsal line." It was doubtless described from preserved specimens on which the red had faded and is the oldest name available for a newt from the Southeast having elongate spots or broken stripes. *Diemyctylus v. vittatus* Garman is a synonym.

To confirm these views I have recently examined the supposed types of *symmetrica* and *dorsalis* in the Philadelphia Academy. Two specimens, Nos. 1582 and 1584, are typical *viridescens* and have the circular black borders which formerly surrounded the red spots still faintly discernible. These specimens are probably the types of *symmetrica.* Three smaller specimens, Nos. 1583, 1585, and 1586, are so badly faded that no spots of any kind are evident. Fortunately, they possess certain structural features which indicate they may well represent the broken-stripe newt and cannot be *louisianensis.* Females of *louisianensis* lack the pits on the side of the head back of the eye, whereas typical *viridescens* and the broken-stripe newt possess them. The five specimens in the Academy collection possess the pits, and since No. 1586 is a female it cannot be *louisianensis*. The reasonable assumption is that these three faded specimens are the types of *dorsalis* and that name should be used for the newt of the Atlantic coastal plain having broken, black-bordered red stripes. Camden is on the fall line, and it may be conjectured that *symmetrica* came from above the falls, where typical *viridescens* is known, and *dorsalis* from below the falls, where the broken-stripe newt has been taken a number of times.

The present known range of *T. v. dorsalis* extends from Harnett and Onslow counties in North Carolina south to Kershaw and Georgetown counties, South Carolina. Intergrades between *dorsalis* and typical *viridescens* have been examined from the collections of C. S. Brimley from Moore, Harnett, Wake, and Craven counties, North Carolina.

While it has been the general practice to regard all red-striped newts from the southeastern states as belonging to a single subspecies, a recent study of all available material from this region demonstrates rather conclusively that the striped newts from southeastern Georgia and northern and central Florida are not only distinct structurally and deserve full specific recognition, but are apparently not in contact at any place with the more northern race, *dorsalis*.

The striped newts of the Atlantic coastal plain are abundant only in certain localities, and I have been unable to find specimens in any collection from the region between Georgetown County, South Carolina, and Charlton and Camden counties, Georgia. In April, 1941, Mr. Arnold B. Grobman and Mr. M. T. Mittleman made a special effort to collect newts in this area, but without success, and Mr. E. B. Chamberlain of the Charleston Museum, who has collected for years in that general vicinity, has not found striped newts south of Georgetown County.

Triturus perstriatus, new species

(Pl. I, Fig. 2)

DIAGNOSIS.—A small, slender species with complete dorsolateral red stripes not black bordered but with a few separate black dots along the margins; venter immaculate or sparsely flecked with small black points; pits on sides of head of male 3–3, lacking on female.

TYPES.—Holotype, male, U.M.M.Z.[1] No. 89761, total length 70 mm.; allotype, female, U.M.M.Z. No. 89762, total length 60 mm.; and paratypes as follows: Bish. coll. from the type locality, 6 adults; U. Fla. No. 43, 15 adults of both sexes collected Feb. 14, 1933, in a pond at Sugarfoot, Alachua County, Florida; C.U. No. 965, 28 adults of both sexes collected June 30, 1922, 2 miles south of Chesser's Island, Okefinokee Swamp, Georgia; U.M.M.Z. No. 74434 (5), Lake Jackson, Lion County, Florida; No. 74437 (5), near Gainesville, Alachua County, Florida.

TYPE LOCALITY.—Dedge Pond, 2 miles east of Chesser's Island, Charlton County, Georgia; February 14, 1936.

DESCRIPTION.—The head is widest opposite the posterior angle of the eyes, the sides behind this point nearly straight and slightly converging posteriorly, in front tapering more abruptly to the bluntly pointed snout; cranial ridges poorly developed or lacking, when present they arise on a line about midway between the anterior angle of the eye and the nostril and extend to the back of the skull. They are nearly parallel to a point opposite the posterior angle of the eye, where they diverge slightly, then round to a blunt point posteriorly. On each side of the head of the male at the level of the eye, a series of 2–3 elongate pits, partially overhung by a low ridge. On the female these pits are lacking, in this respect differing from typical *viridescens* and *dorsalis* and resembling *louisianensis*. The trunk is somewhat compressed, the costal grooves not developed. The hind legs of the males are noticeably larger than the forelegs and provided along the posterior margin with a thin, fleshy keel; when appressed to the side the tip of the longest toe nearly or just reaches the elbow of the foreleg. Toes, 5–4, those of the hind feet, 5–1–2–4–3, the fifth very short and webbed at base, the first thickened and rounded at tip; toes of fore feet, 1–4–2–3. Tail strongly compressed, in the aquatic adults with a dorsal keel which arises above the insertion of the hind legs, reaches its greatest width a short distance behind the vent, and tapers evenly to the tip; ventral keel arises just behind the vent and continues evenly to the tip; vent of the male large, strongly protuberant, the opening directed obliquely downward and backward and lined with many slender filaments; tongue small, elongate oval; vomeropalatine teeth in 2 long series which arise opposite the hind margin of the inner nares and extend, narrowly separated, in parallel lines for two-thirds their length, then diverge abruptly.

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[1] University of Michigan Museum of Zoology; other abbreviations used in this paper are: Bish. coll. = Bishop collection; U. Fla. = University of Florida; C.U. = Cornell University; and C.M. = Carnegie Museum.

COLOR.—The ground color above, compared with that of *T. v. viridescens* and *T. v. dorsalis*, is much more uniformly developed, dark brown to olive green. On either side a narrow dorsolateral stripe which varies from bright red to red strongly suffused with dusky. On the majority of individuals, these light stripes arise on the head between the eyes and continue unbroken for the length of the trunk and on the basal half of the tail; on the distal half of the tail they may be lacking or broken into separate spots. Often there is a middorsal line lighter than adjoining parts but not red. The dorsolateral red stripes may have separate black flecks on either side, but the heavy black border of *T. v. dorsalis* is lacking. In some specimens there are a few small red spots on the lower sides between and slightly above the level of the legs. In the majority of specimens there are a few small, black flecks scattered over the dorsal, pigmented areas; in some these flecks are mainly restricted to series which extend along either side of the middorsal light stripe and the bases of the tail fins, sometimes a few on the tail proper and on the sides of the vent. The dorsal and lateral pigmented areas extend on the side of the head to the level of the eye, on the trunk to pass just above the legs, and on the tail at different levels in different individuals but mainly restricted to the upper two-thirds. The ventral surfaces are light yellow, usually with a few, small, widely separated black flecks; an occasional individual may be more heavily spotted, and in about 25 per cent of all specimens the belly is immaculate. The upper half of the limbs are pigmented like the sides.

This is by far the smallest species of the genus, 86 sexually mature adults of both sexes from Georgia and Florida average only 63.4 mm., with extremes of 52 mm. and 79 mm.

The terrestrial efts are known both from Georgia and Florida. The dorsolateral red stripes are present as in the adults, but the general ground color is orange red, the skin is roughened, the tail less compressed. Specimens I have examined varied in length from 43 to 51 mm. in total length. Larvae usually have a dorsolateral series of pale spots and scattered dusky spots on sides and fins of tail; they vary in length, in the series available, from 25 to 37 mm. Often neotenic individuals are found, and these attain the size of the aquatic adults. A female with large eggs taken March 15, 1935, at Aesopus Pond, Alachua County, Florida, by Henry G. M. Jopson, had a series of pale spots within a continuous dorsolateral light band and ground color essentially like that of adults.

Little is known of the breeding habits of this species. I collected, near Chesser's Island, Okefinokee Swamp, Georgia, Feb. 14, 1936, a number of adult males on which the sexual excrescences were developed, and in the Cornell University collection are a number of specimens of both sexes from the same locality which were in breeding condition June 30, 1922.

Among some salamanders collected and sent me by Mr. C. E. Mohr from Texas is a series of 20 specimens taken in a small lake at the head of the San Marcos River, Hays County, June 22, 1938. These represent a hitherto undescribed species of *Eurycea*, the smallest yet known.

***Eurycea nana*, new species**
(Pl. I, Fig. 1)

DIAGNOSIS.—A small, slender, neotenic species uniformly light brown above with a dorsolateral row of pale spots on either side of the mid-line; yellowish white below; 16 or 17 costal grooves.

TYPES.—Holotype, male, U.M.M.Z. No. 89759, 49.5 mm. total length; allotype, female, U.M.M.Z. No. 89760, 48 mm. long. Paratypes, 3 males, 3 females mature, and 12 larvae, 20 to 41 mm. in length, in Bish. coll.

TYPE LOCALITY.—Lake at the head of the San Marcos River, at San Marcos, Hays County, Texas.

DESCRIPTION.—The head is narrow, the sides back of the eyes parallel, in front converging gently to the broadly rounded snout. The eyes are of moderate size, partly or completely surrounded by a dark ring, the long diameter about 1¼ in the snout; the iris dark with only a few light flecks. Gills well developed and highly pigmented, the rachises flattened above and increasing in length posteriorly, the filaments slender and pigmented nearly to the tips. Trunk slender, somewhat compressed, flattened above and with an impressed median dorsal line which extends from the base of the tail to the dorsal surface of the head, where it forks and sends a branch to each eye. There are 16 or 17 costal folds, these counts about equally represented in the series examined, and 6 to 7 intercostal folds between the toes of the appressed limbs. The tail is subquadrate in section at base, slender and compressed beginning a short distance behind the vent, and with a dorsal keel that arises behind the posterior end of the vent; ventral tail keel limited to the distal third. The legs are small and slender; toes, 5–4, long, slender, those of the hind feet 1–5–2–4–3 in order of length from the shortest; toes of fore feet 1–4–2–3. Tongue and teeth larval in character. The teeth on the premaxilla average 11 and vary from 10 to 13 in most individuals. In a single sexually mature female 50 mm. long, these teeth are enlarged and the number reduced to 7; vomerine teeth average 11.7 and vary from 9 to 14; pterygoid teeth average 4.8 and vary from 4 to 6. In 2 sexually mature males, 44 and 49.5 mm. long, respectively, the teeth on the pterygoid are reduced to 2 on each side, suggesting incipient metamorphosis which may or may not be completed.

MEASUREMENTS

Sex	Length in mm.		Head		Costals	Intercostal	Teeth		
	Total	Tail	Length	Width		Folds	Premaxillary	Vomerine	Pterygoid
♂	49.5	22	4.5	3.5	16	6	13	11–12	2–2
♂	48.0	21	5.0	3.5	16	6	13	11–12	5–5
♂	44.0	16*	5.0	3.5	17	6	12	10–11	2–2
♂	41.0	16	4.5	3.5	16	6	11	9–11	4–4
♀	50.0	20	5.0	4.5	17	7	7	11–12	5–5
♀	48.0	21	5.0	3.5	16	6	12	12–14	5–5
♀	44.0	19	5.0	3.5	16	6	12	12–12	4–5
♀	41.0	18	5.0	3.5	17	6	10	10–10	5–6

* Tip lost.

The specimens are remarkably uniform in color and pattern. The general color above is light brown, the dark chromatophores grouped into little clusters separated by inconspicuous, narrow, light lines. The pigment extends on the side of the head to the level of the base of the first gills and involves the upper jaw and posterior part of the lower jaw; on the sides of the trunk to involve the upper half of the legs and on the tail nearly to the ventral keel. The ventral surfaces are white, tinged with yellowish on the tail. Along each side of the midline of the back is a series of 7 to 9 small, irregular light spots and rarely, a second incomplete series on the sides above the insertion of the legs. A few small light spots regularly invade the middorsal region. The testes are strongly pigmented with black, and the peritoneum of both sexes is spotted with scattered black chromatophores.

The sexes may be distinguished by the size and shape of the vent which is larger in the male and has the opening lined with short papillae. In the female the vent is a simple slit with the sides anteriorly thrown into narrow folds. Both males and females are mature at a length of 41 mm.

Eurycea nana differs from *E. neotenes*, the only other species of the genus from the general locality, in its smaller size, in its uniformly light brown dorsal color relieved only by a few small light spots, and in its more slender form and longer, more slender toes.

Early in April, 1941, I received a collection of 24 living *Necturus* from Lake Winnebago, Wisconsin. A majority of these differ markedly from *Necturus m. maculosus* from the Allegheny River (Ohio drainage basin) and tributary streams of Lake Ontario in color, pattern, and certain structural features, a few are intermediate in character.

Necturus maculosus stictus, new subspecies

(Pl. II, Figs. 3–4)

DIAGNOSIS.—A broadheaded *Necturus* with darkly pigmented dorsal and ventral surfaces and with few or no large black spots but many round black dots.

TYPES.—Holotype, male, U.M.M.Z. No. 89765, total length 316 mm.; allotype, female, U.M.M.Z. No. 89766, total length 310 mm.; paratypes, 7 males and 15 females, in Bish. coll.

TYPE LOCALITY.—Lake Winnebago, Wisconsin, April 1, 1941; collected by J. Pawlack.

DESCRIPTION.—The head is broad and flat, widest immediately in front of the gills, the sides converging slightly to the angle of the jaws and more abruptly from this point to the broadly truncated snout. The eye is small, the horizontal diameter about 4–4½ in the length of the snout, the iris blotched or flecked with yellow above and below the pupil. Gills short and brushy, the third longest. The trunk is stout, flattened above and below, rounded on the sides. Tail short, comprising from 27 to 31 per cent of the total length in the males and from 29 to 32 per cent in the females, broadly oval in section at base and with a dorsal keel that arises opposite the hind margin of the vent as a thick cordlike ridge and becomes compressed and thin-edged at about one-half the length; ventral fin thin distally becoming thickened at about the distal third. The legs are relatively short and stout. Toes 4–4, short, broad, and blunt tipped, usually 1–4–2–3 in order of length from the shortest, sometimes 1–2–4–3. There are usually 15 costal grooves, occasionally 16, and about 6 intercostal spaces between the toes of the appressed limbs. The head width averages 86.5 per cent of the head length as compared with 81 per cent in a series from the Allegheny River, Cattaraugus County, New York, and 82 per cent in a similar series from Salmon Creek, Monroe County, New York. There are significant differences in the number of teeth, the pterygoids averaging 6.2 and ranging from 5 to 8 in a series of 20 from Lake Winnebago, compared with 5.2 and a range of 5 to 7 in a similar series from Salmon Creek and 5.3 in a series from the Allegheny River. The premaxillary teeth average 10.7, as compared with 11.8 in specimens from the Allegheny and Salmon Creek. Another distinguishing structural difference is to be found in the form of the vent which, in the male, is lined with slender finger-like papillae and limited behind by a transverse groove and a pair of fleshy triangular lobes directed mesally. In *N. maculosus maculosus,* the vent is provided posteriorly with a pair of nipple-like papillae directed inward and backward.

MEASUREMENTS

Sex	Length in mm.		Head		Head in length	Teeth			Costals
	Total	Tail	Length	Width		Premaxillary	Vomeropalatine	Pterygoid	
♂	320	90	50	42	6.4	9–9	11–12	5–5	15
♂	299	88	48	40	7.0	9–10	11–12	5–6	15
♂	298	83	48	41	6.2	10–11	12–12	7–7	15
♂	256	71	35	32	7.3	9–10	11–12	6–7	15
♀	362	111	56	51	6.7	14–15	15–14	8–8	16
♀	308	92	46	42	6.7	10–12	13–12	6–6	15
♀	298	88	45	40	6.6	10–11	12–13	6–7	15
♀	293	91	42	37	7.0	12–12	11–11	6–6	15
♀	253	77	38	31	6.7	10–9	11–12	5–5	15
♀	238	75	36	30	6.6	11–10	11–11	6–6	15

The general ground color is dark gray, almost black. In life there is a superficial layer of tan chromatophores, which obscures the ground color in varying degrees in different individuals. The light chromatophores may be small, very numerous, and evenly distributed, giving a uniformly tan specking over the dark ground, or, in a few individuals, the light pigment may be lacking in circular areas on the back and sides, permitting the dark ground color to show through. These dark spots, when present, vary from a few to 30 or 40. In addition to the large dark spots there are a multitude of small round black dots mainly confined to the dorsal surfaces, but in a few specimens continued on the sides and ventral surfaces. These small black dots are absent in typical *maculosus*. The ventral surfaces are very dark, with only the slightest suggestion of a lighter area along the mid-ventral region in a few individuals. In some there are a few large dark spots on the belly, and in many a scattering of small tan flecks, most abundant along the sides. The upper surface of the limbs is colored like the back, the lower like the belly. The margins of the tail fins are sometimes tinged with ocher in irregular blotches. On small specimens there is a dark bar which extends from the nostril through the eye on the side of the head to the base of the middle gills; in old dark specimens, this bar is obscured in the general coloration of the sides of the head.

In preserved specimens the tan fleckings nearly or quite disappear, and the general color is deep gray against which the dark dots and larger black blotches are relatively inconspicuous.

The important differences between this subspecies and typical *maculosus* may be briefly summarized as follows: in the Winnebago specimens the ground color is much darker, the large dark spots usually absent and when present fewer and larger, a multitude of small black dots generally scattered over the dorsal and sometimes on the lateral and ventral surfaces. Structural differences are to be seen in the greater width of the head in proportion to the length, in the larger number of pterygoid teeth, fewer premaxillary teeth, broader blunter toes, and the form of the vent of the male.

Viosca (1937: 129) has figured this subspecies, the female being typically marked, the male with a larger number of spots than is usual.

Mr. Arnold B. Grobman has examined specimens in the University of Michigan collection, and a specimen, No. 82104 from Mackinac County, Michigan, seems to represent this subspecies.

For many years I have had 3 specimens of a *Desmognathus* from Demorest, Georgia, which is strikingly different in appearance from any described species. Recently, some additional specimens from this same general region have been examined and appear to be intermediate in character between the Demorest specimens and *Desmognathus quadramaculatus.*

Desmognathus quadramaculatus amphileucus
new subspecies

(Pl. I, Fig. 3)

DIAGNOSIS.—A small *Desmognathus* with snout, distal half of tail, and the limbs white or very lightly pigmented.

TYPES.—Holotype, female, U.M.M.Z. No. 89767, total length, 90 mm. Paratypes, 2 females from the same locality in Bish. coll.

TYPE LOCALITY.—Demorest, Habersham County, Georgia, April, 1926, M. E. Phillips, collector.

DESCRIPTION.—The head has the sides back of the eyes gently converging to the lateral extensions of the gular fold, in front more abruptly narrowing to the bluntly pointed snout. The eyes are large and very strongly protuberant, the horizontal diameter slightly less than the length of the snout. The trunk is somewhat depressed, and with an impressed middorsal line; the sides rounded. Costal grooves 14 counting 1 in the axilla and 2 that run together in the groin, and only a single intercostal fold between the toes of the appressed limbs. Tail subquadrate in section at base becoming compressed and provided with a thin keel above immediately behind the vent; ventral tail keel narrow and limited to the distal third. Legs moderately stout. Toes, 5–4, long, slender and tapering, those of the hind feet, 1–5–2–4–3 in order of length from the shortest, clearly webbed at base; toes of the forefeet, 1–4–2–3. Tongue broadly heart-shaped, thin at the margins and free at the sides and behind, the plicae narrow and radiating from the center toward the sides and anterior margin. Vomerine teeth, 7–7 in short series which arise slightly behind and inside the inner margin of the inner nares and curve inward and backward toward the mid-line where they are separated by about the diameter of a naris. Parasphenoid teeth in 2 long, slender, club-shaped patches slightly in contact anteriorly and separated from the vomerine by about twice the diameter of a naris.

The white on the dorsal surface of the head includes the eyes and extends backward in a triangular point between them; on the sides of the head to include the jaws and part of the neck and on the ventral side from the tip of the lower jaw half way to the gular fold. The distal half of the tail is white, and the limbs are very lightly pigmented. The back of the head, the dorsum and upper sides of the trunk, and the basal half of the tail deep brown with only a suggestion of lighter markings along the costal grooves, the vertical grooves of the tail, and the anterior part of the dorsal tail fin. The lower sides are mottled, yellowish white and brown, the ventral surfaces lightly pigmented with brown except as indicated above. Total length, 90 mm.; tail, 41 mm.; head length, 13 mm., width, 9 mm.

The 2 paratypes are marked essentially as the type. The first, 81 mm., total length, tail, 35.5 mm., has 7–7 vomerine teeth as in the type. The second, 80 mm., tail, 29 mm. (tip lost), has 8–10 vomerine teeth.

Remarks.—Specimens which I regard as intermediate in character are from the following localities:

Liberty, South Carolina, May–June 1928. 3 females, J. F. Allen coll.
Aquone, North Carolina, April 19, 1938. 1 male, Bish. coll.
½ mile south of Jack's Gap, Union County, Georgia, June 8, 1934, 1 female, Francis Harper coll.
Headwaters of Town Creek, Union Co., Georgia (near Soapstone Gap), June 8, 1934, Francis Harper coll.
Headwaters of Helton Creek, 1 mile northwest of Frogtown Gap, Union County, Georgia, June 1, 1934, 1 male, 1 female, Francis Harper coll.

Head of Frogtown Creek, Frogtown Gap, Lumpkin County, Georgia, May 30, 1934, 1 female, Francis Harper coll.

Between Lake Toxaway and Cashiers, Transylvania County, North Carolina, May 3, 1933, 2 females, Francis Harper coll.

These individuals are intermediate in size between typical *quadramaculatus* and *amphileucus* and have the head, tail, and limbs lightly pigmented.

In April, 1938, I visited the Cascade Caverns in Carter County, Kentucky, and collected, among other salamanders, a single *Pseudotriton,* which differed markedly from the species known to me. Recently, in examining rather extensive series from various collections, additional specimens have been found which justify the recognition of this form as a subspecies of *Pseudotriton montanus.*

Pseudotriton montanus diastictus, new subspecies

(Pl. II, Figs. 1–2)

DIAGNOSIS.—A *Pseudotriton* having a clear ground color in life, light coral pink, clear brilliant red or light brown above, marked with well-separated rounded black spots concentrated along upper sides and never extending below the level of the legs; venter light, entirely without darker markings except, rarely, the extreme margin of the lower jaw.

TYPES.—Holotype, male, in Bish. coll., total length, 142 mm. Paratypes, U.M.M.Z. No. 75886 (3), Bell County, Kentucky; C.M. Nos. 19401, 19407, 17482, 10615, Cabell County, West Virginia; 13000, 15399–400, Mercer County, West Virginia; 17577, Wayne County, West Virginia; 18082, Lincoln County, West Virginia; 7459, 19238, Kanawah County, West Virginia; 19448, Putnam County, West Virginia; 17575, Boyd County, Kentucky; 16967, Laurel County, Kentucky; C.U. No. 3087, Sandy Creek, Jackson County, West Virginia.

TYPE LOCALITY.—Cascade Caverns, Carter County, Kentucky, April 15, 1938.

DESCRIPTION.—The head is rather small, the sides back of the eyes nearly parallel, in front tapering to the bluntly truncated snout; head not strongly convex above, back of the eyes, as in typical *montanus*, but depressed or slightly rounded over; eye small, the horizontal diameter about twice in the snout; a slightly impressed line from the posterior angle of the eye to the lateral extension of the gular fold, a short vertical groove from this line to the angle of the jaw; trunk less stout than in typical *montanus;* 17 costal grooves counting 1 in the axilla and 2 that run together in the groin, occasionally 16, and 5½ to 6½ intercostal folds between the toes of the appressed limbs, in adults; tail subquadrate in section at base becoming broadly oval a short distance behind the vent and compressed and sharp-edged above distally; no ventral tail keel; legs stout, toes 5–4, those of the hind feet, 1–5–2–3–4 or 4–3 in order of length from the shortest; toes of forefeet, 1–4–2–3; vomero-parasphenoid series continuous, vomerine usually 12 to 15 in series that arise behind or just outside the outer margin of the inner naris and sweep inward in a broad curve toward the midline, then backward for a short distance, nearly parallel, before joining the parasphenoid; parasphenoid patches narrow anteriorly, club-shaped, and well separated.

In life, the type was clear, brilliant red above, the dark spots jet black. The dark spots usually larger and fewer than in typical *montanus*, more nearly uniform in size and confined to the dorsal surface of the head, trunk, tail, and limbs and sides of trunk and tail to a line which passes above the legs; ventral surfaces lighter, entirely lacking in darker markings and in this strikingly distinct from most adults of typical *montanus*. The dark spots are generally uniform in size, occasionally smaller on the sides above the level of the legs, and often somewhat concentrated dorsolaterally.

In 1820 Rafinesque (p. 4) described *Triturus hypoxanthus* from Kentucky, and Dunn (1926: 286) has included this name, doubtfully, in the synonymy of *P. montanus montanus*. I have examined Rafinesque's original description, which is as follows: "Brown above, yellow beneath; tail acute, slightly compressed, one-half of the total length. . . . " "This species is found in Kentucky, where it is called Ground Puppet, because it is often found in the lobster's holes in moist ground; total length six to eight inches." This is the complete description, and there is nothing in it to identify the salamander with the subspecies described above. No mention is made of the black spots, and the size, six to eight inches, indicates a species much larger than *P. montanus diastictus*, thirteen adults of which average only $5\frac{5}{16}$ inches, with extremes of $3\frac{7}{16}$ inches and $6\frac{1}{8}$ inches. This subspecies is apparently limited to the unglaciated plateau country of southern Ohio, central and eastern Kentucky, southwestern West Virginia, western Virginia, and eastern Tennessee.

In 1936 I had the opportunity to travel through the Pacific states and was able to collect several hundred newts at various localities from southern California to the Olympic Peninsula in Washington. While studying this material it became apparent that the newts which have been regarded as *Triturus granulosus* readily split into northern and southern groups on the basis of structural and pigmentation differences. Specimens from south of San Francisco Bay, in Santa Clara and Santa Cruz counties, represent the southern form at its best development; others from Ukiah, Mendocino County, northward, the northern form. Individuals which appear intermediate in character have been examined from Marin, Napa, and southern Mendocino counties.

Triturus granulosus twittyi, new subspecies

(Pl. I, Figs. 4–5)

DIAGNOSIS.—A rough skinned newt having many brown tipped tubercles on back and belly; pigment on lower sides involving only the upper half or two-thirds of the legs; average ratio of pigmented dorsal and lateral areas to unpigmented venter as 60 to 40; finger and toes moderately long and slender.

TYPES.—Holotype, male, U.M.M.Z. No. 89763, total length 181 mm.; allotype, female, U.M.M.Z. No. 89764, total length 160 mm.; paratypes as follows: Bish. coll. 8 males and 10 females from Saratoga, California, May 20, 1936; U.M.M.Z.

Nos. 55277–84, Corralitos Creek, Santa Cruz County, California; U.M.M.Z. No. 66654 (3), 3 miles north of Corralitos Creek; U.M.M.Z. No. 66655 (4), Bodfish Canyon, Santa Clara County, California. All University of Michigan paratypes collected by Dora L. Dice.

TYPE LOCALITY.—Saratoga, California, May 20, 1936; collected by V. C. Twitty, Margaret Wright, and S. C. Bishop.

DESCRIPTION.—Viewed from above, the sides of the head back of the eyes broadly rounded to the lateral extensions of the gular fold, in front tapering to the bluntly pointed snout. The eyes are of moderate size, the horizontal diameter about twice in the snout; eye crossed by a dark horizontal bar, the iris above silvery, below mottled silvery and black. Trunk stout, rounded above and on the sides, flattened below. Tail subquadrate in section at base, becoming compressed and sharp-edged above a short distance behind the vent and strongly compressed distally; dorsal tail keel of breeding males high and extending above level of back. Legs and feet stout. Toes, 5–4, moderately long and slender, except in the breeding season when they become somewhat depressed, widened at base, and pointed distally; toes of hind feet, 1–5–2–4–3 in order of length from the shortest, toes of forefeet, 1–4–2–3. Except in case of adults in actual breeding condition the skin is roughened and finely tuberculate, the brown tipped tubercles abundant on the belly, usually fewer on the back and sides. Tongue small, nearly circular in outline and slightly free at the sides. The palatine teeth in 2 lines united anteriorly, diverging slightly for one-half their length, then more strongly so that the rearmost are separated by about the distance between the inner nares. Vent of female small, conelike, the opening directed obliquely downward and backward; vent of male large, strongly protuberant; in the breeding season, the opening lined anteriorly with fleshy folds tipped by short papillae. Males in breeding condition often with soles of feet and undersurface of thighs black.

COLOR.—The general ground color above varies from dark yellowish brown to burnt umber, the dark pigment covering the dorsal surfaces and the sides to involve the upper half or two-thirds of the legs, the upper three-fourths of the tail, the sides of the head to just below the nostril and eye. The ventral surfaces vary from yellow to orange, less bright than in *T. g. granulosus.* Usually the pigment of the lower sides is somewhat diffuse, the line of separation between the unpigmented venter and pigmented sides rather irregular. Occasionally, in the male, a lobe of pigment encroaches on each side of the vent.

This subspecies differs from *T. g. granulosus* mainly in its larger average size, in having many more brown tipped tubercles, and in the pigmentation of lower sides never involving the ventral surface of legs. When series of specimens are measured, the proportion of the pigmented dorsal and lateral areas to the unpigmented venter averages 60 per cent compared to 62 to 70 per cent in typical *granulosus.*

J. R. Bailey (1937: 4) has called attention to the variability exhibited by individuals of *Plethodon glutinosus* from the mountainous regions of southwestern North Carolina and northern Georgia. I have collected in these areas on two occasions and have encountered some individuals in the Nantahalas which cannot be assigned to *Plethodon glutinosus* because, while superficially resembling that species, they also exhibit many of the characters of *Plethodon shermani.* On April 19, 1938, I collected with Dr. U. B. Stone and Mr. Robert Van Auken along Wine Spring Creek, about a mile north-northeast of Aquone, North Carolina. There beneath logs and slabs of rock we took 10 specimens, each of which possessed red in greater or less amount on the legs and white spots on the sides of the head, trunk, and tail. The dorsal surfaces had the ground color intermediate between that of *shermani* and *glutinosus,* but closer to the latter. The ventral coloration was again intermediate with the throat nearly as light as typical *shermani* and with the belly darker than in *shermani* but not so black as in *glutinosus.* In *shermani* the vomerine teeth average 8.11 per series (18 series); in *glutinosus* from the same general region the average is 11.61 for the same number of specimens. The specimens of intermediate character from the Nantahalas, 4 males and 6 females, average 8.44, and are nearer to *shermani* in this respect. Typical examples of these species, both present in the Nantahalas but not taken at this precise locality, differ conspicuously in head shape, *shermani* having the head oval in outline and *glutinosus* having the sides of the head back of the eyes nearly parallel. In the specimens from near Aquone the head shape is again intermediate, but nearer that of *glutinosus*. East of the Nantahalas I have taken both species, but here there was no evidence of intergradation. Bailey (1937: 4) mentioned 2 specimens of *shermani* from Wayah Bald, which had a considerable amount of white pigment on the sides between the legs. In view of the intermediate character of the specimens from near Aquone, I regard *shermani* as a subspecies of *Plethodon glutinosus*.

While studying *Eurycea l. longicauda* and *E. melanopleura* in my own collection, I found some specimens from Imboden, Arkansas, and from several localities in eastern Missouri to be intermediate in character between these forms. Altogether 10 specimens from the localities indicated below were found to be intergrades.

Imboden, Lawrence County, Arkansas (5)
Cave Springs Caverns, Carter County, Missouri (1)
Big River Heights, Washington County, Missouri (1)
Merdmec Highlands, St. Louis County, Missouri (3)

These localities lie on a north-south line, where the eastern boundary of the range of *melanopleura* is narrowly overlapped by the westernmost range of *longicauda*. Typical *melanopleura* has the sides of the trunk next to the dorsal light stripe dark brown, usually with small light dots or dashes, and the sides of the tail nearly uniform reddish brown or brown spotted or mottled with yellow. In *longicauda* the upper sides of the trunk are yellow or orange with black dashes, and the sides of the tail are marked with vertical crescentic or dumb-bell-shaped bars. The intergrades have the upper sides marked somewhat like *longicauda* on a ground color like *melanopleura*, while the sides of the tail show some development of vertical dark bars combined with the spotting of *melanopleura*.

In view of the intermediate character of these specimens, it is proposed to regard *melanopleura* as a subspecies of *longicauda*.

Plethodon clemsonae was described by C. S. Brimley in 1927 (pp. 73–75) from Jocasse, South Carolina. This species was recognized in the third edition of the Stejneger and Barbour *Check List* and dropped from the fourth, on the assumption that it was not distinct from *Plethodon metcalfi*.

On April 8, 1941, Arnold B. Grobman and M. T. Mittleman collected at the type locality with Dr. Franklin Sherman and found 2 adult specimens which agree in all essential details with Brimley's description of the species and differ markedly from *P. metcalfi*.

In life the ground color above is blue-black. Scattered over the dorsal surface of the head, trunk, and basal part of the tail are many large, irregular light gray, lichen-like patches. On the head and base of the tail the patches may be tinged with brassy. The patches extend to the lower sides, but are absent on the ventral surface, except a few at the gular fold and lower surface of the forelegs. The legs are dark on the basal joints, lighter distally, and tinged with brownish. The throat and soles of the feet are light gray, the belly and ventral surface of the tail black, fading slightly toward the tail tip.

Manculus quadridigitatus remifer Cope.—I cannot recognize this subspecies as distinct from the typical form.

ACKNOWLEDGMENTS.—I am indebted to many individuals and institutions for the loan of critical material and especial thanks are due the following: C. M. Bogert, American Museum of Natural History; A. F. Carr, University of Florida; E. B. Chamberlain, Charleston Museum; Doris M. Cochran, U. S. National Museum; Helen T. Gaige, University of Michigan Museum of Zoology; C. J. Goin, University of Florida; Arthur Loveridge, Museum of Comparative Zoology, Cambridge; C.

E. Mohr, Academy of Natural Sciences of Philadelphia; G. S. Myers, Stanford University; M. G. Netting, Carnegie Museum; K. P. Schmidt, Field Museum; V. C. Twitty, Stanford University; and A. H. Wright, Cornell University. Thanks are also due Mr. Arnold B. Grobman of the University of Rochester, who has been helpful in many ways, and Mr. Ray Maas, technician of the Department of Biology, University of Rochester, for his skilled help in photography.

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PLATE I

FIG. 1. *Eurycea nana.* Paratype, male; actual length, 39 mm.

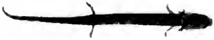
FIG. 2. *Triturus perstriatus.* Paratype, male; actual length, 63 mm.

FIG. 3. *Desmognathus quadramaculatus amphileucus.* Type, female; actual length, 90 mm.

FIG. 4. *Triturus granulosus twittyi.* Paratype, female. Saratoga, California. V. C. Twitty coll. Natural size.

FIG. 5. Same, ventral view.

Figures 1–3 from preserved specimens.



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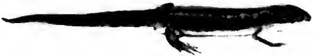

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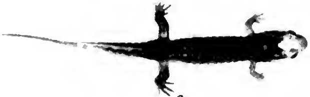

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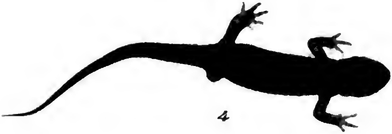

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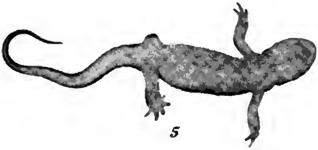

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PLATE II

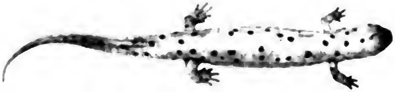
Fig. 1. *Pseudotriton montanus diastictus.* Type, male; actual length, 142 mm.

Fig. 2. Same, ventral view.

Fig. 3. *Necturus maculosus stictus.* Paratype, female; actual length, 363 mm.

Fig. 4. Same, ventral view.

Figures 1–2 from preserved specimen.



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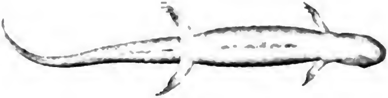

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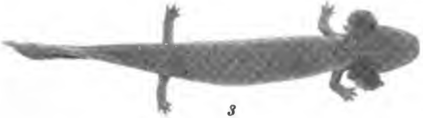

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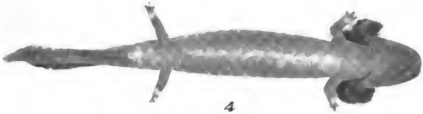

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Vol. 59, pp. 1-8 March 11, 1946

PROCEEDINGS

OF THE

BIOLOGICAL SOCIETY OF WASHINGTON

FOUR NEW SPECIES OF DICTYNA.

BY SHERMAN C. BISHOP AND CLAIRE RUDERMAN.[1]

The new species here described are from the Cornell University collection and were made available through the courtesy of Dr. Helen Blauvelt. The types will be deposited at Cornell.

These four species are from a series of thirteen described, but not published, several years ago. The remaining nine species of the series have either been described recently by other workers or are in the process of description by Dr. W. J. Gertsch, of the American Museum, who kindly checked our material with his to avoid possible duplication of effort.

Dictyna cornupeta new species.

(Figs. 1-2.)

Male. Length, 3 mm. Cephalothorax with the head relatively broad, light yellow-brown with the radiating lines on the thorax and four longitudinal lines on the head darker. Sternum yellow in some individuals with the margin narrowly black and with a dark median stripe which does not reach the margin either in front or behind. Labium slightly dusky. Endites yellow. Chelicerae light dusky orange, concave, strongly bowed apart in the middle leaving an ovate opening between them closed below by a pair of opposed teeth; lateral ridges at base of chelicerae short, not well developed, not tooth-like. Legs and palpi pale yellow, tarsus of latter dark. Abdomen above pale yellowish with a basal lanceolate dark stripe followed by a diamond-shaped median spot and this by a double row of irregular spots connected by narrow chevrons and to the dark on the sides by oblique lines; venter yellowish or whitish, with two dark spots in front of the epigastric furrow, a dark spot at each end of this furrow, a dusky median area back of it and a dark spot at each end of the spiracular furrow.

Posterior eyes in a gently recurved line, equidistant, separated by two-thirds the diameter. Anterior eyes in a straight line, separated by a little less than the diameter and from the lateral by less than the radius.

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[1] Department of Biology, The University of Rochester.

Femur of palpus short, thicker distally. Patella short and broad. Tibia moderately long, viewed from the side gently convex above, more strongly concave below; viewed from above, the mesal side convex and the lateral side concave, the distal margin obliquely truncate. Tibia armed dorsolaterally at base with a short, stout, erect process bearing at tip two black teeth set in sockets. The embolus arises at the base of the bulb from a moderately swollen base; it is black and is strengthened by three thickened ribs. The conductor lies free from the cymbium for a considerable distance; it ends basally in a black pointed process which is curved around a circular passageway for the tip of the embolus.

Holotype male, Arizona: Texas Pass, Dragoon Mts., Aug. 21, 1917; paratype, Wyoming: Yellowstone Lake, Yellowstone National Park, Aug. 29, 1927, 1 male.

Dictyna tridentata new species.

(Figs. 3-4.)

Male. Length, 2.8 mm. Cephalothorax dark mahogany brown, darker radiating lines on the thorax and longitudinal lines of fine white hairs on the head. Sternum dusky orange, very much darker on margin and posteriorly. Labium nearly black, lighter distally. Endites dark dusky orange. Chelicerae dusky with a tinge of orange showing through, strongly concave and strongly bowed apart in the middle, face of chelicerae flat transversely with mesal and lateral edges clean cut at a right angle, the lateral ridges at base well developed but without a tooth. Legs dull orange with faint, darker annulations on posterior femora and at the ends of the segments. Palpi dull orange. Abdomen reddish orange with distinct black markings; a basal median wedge-shaped mark constricted at posterior third, followed by a series of narrow chevrons connected laterally with a row of irregular spots; venter broadly dark medially, lighter on the sides.

Posterior eyes almost in a straight line, the median separated by more than the diameter and slightly farther from the lateral. Anterior eyes in a straight line, the median separated by nearly twice the diameter and from the lateral by two-thirds the diameter.

Femur of palpus rather stout, from above widened distally, gently curved downward. Patella short and broad. Tibia rather stout, viewed from the side concave below and convex above beyond the process; viewed from above, the mesal side gently convex, the lateral, concave, the distal margin gently concave, the lateral angle widened and produced forward; tibia armed dorsally near base with a stout, flattened, erect process gently curved forward and about three-fourths as long as width of segment, bearing at tip three black teeth in a row set in sockets. The embolus arises on the mesal side of the bulb from a distinctly swollen bulb-like base, passes along the edge of the cymbium to the tip of the bulb where it enters the groove of the conductor. The conductor lies close to the cymbium throughout its length and ends basally in a narrow sharp-pointed process, finely denticulate at tip.

Holotype male, Wyoming: Summit of the Grand Teton Pass, July 4, 1933.

Dictyna peragrata new species.

(Figs. 5–8)

Male. Length, 2 mm. Cephalothorax chestnut brown with dark radiating lines on the thorax and fainter longitudinal lines on the head. Sternum dark gray over orange yellow, dark at margin and behind. Labium dark at base. Endites yellow suffused with dusky. Chelicerae chestnut brown, strongly concave and bowed apart in the middle, lateral margin convex, the lateral ridges at base well developed. Legs pale yellowish suffused with dusky and with dark annulations at the ends of tibiae and metatarsi. Abdomen light above with a basal dark wedge-shaped mark connected with a broader black spot, followed after an interval by a black chevron and other indistinct markings. Sides of abdomen dark.

Posterior eyes oval, in a straight line, equidistant, separated by a little more than the long diameter. Anterior eyes in a straight line, the median separated by a little more than the diameter and from the lateral by a little less.

Femur of palpus nearly straight and cylindrical. Patella short, as broad as femur. Tibia short, viewed from the side strongly concave below, straight above beyond the two teeth; viewed from above widened distally on the outer angle, the mesal side straight, the lateral, concave, armed near base dorsolaterally with two nearly sessile black teeth set in sockets. The embolus arises from a swollen bulb-like base on the ventral side near base. It is rather stout and jet black. Near the distal end of bulb it enters the groove of the conductor. The conductor lies free from the edge of the cymbium for some distance, basally it is moderately thickened and ends in a narrow, slender slightly curved process, serrated along the inner margin of the tip.

Female: Length 2 to 2.25 mm. Similar to the male in form but generally lighter in color, the cephalothorax dusky orange yellow, the abdomen mottled gray and yellow, the basal mark, when present, brown. Epigynum of adult (Fig. 7) with a triangular median lobe, the apex directed forward and with the margins continued laterally. The openings, in mature individuals, show as dark oval cavities on either side of the median lobe. Posteriorly, the receptacles show through as dark round or oval blotches. In juvenile females (Fig. 8), the openings are indistinct and the receptacles are faintly outlined beneath the surface.

Holotype male. Washington: Edmonds, August 16, 1927; allotype, California: Miranda, June 4, 1936; paratypes, Washington: Friday Harbor, June–July, 1928, 3 males, 3 females; California: Miranda, June 4, 1936, 1 male, 3 females.

Dictyna francisca new species.

(Figs. 9–11.)

Male. Length, 2–2.2 mm. Cephalothorax reddish orange with darker radiating lines to dark brown in preserved specimens, head high and narrow, clothed with five longitudinal rows of white hairs. Sternum dark grayish orange narrowly black at margin. Labium darker, endites a little lighter. Chelicerae dull orange brown, long, concave, bowed apart in the middle, the lateral ridges at base short, thin, forming a small but distinct tooth. Legs and palpi pale orange yellow. Abdomen yellowish white above, with darker reticulations and with a dark median basal mark which is strongly constricted and then enlarged to form a distinct median spot; farther back there is a double row of 3 or 4 dark spots, the last two pairs connected by transverse bars which are sometimes very heavy. Sides of abdomen grayish to blackish, venter broadly pale across the middle, dusky in front and behind. Abdomen clothed with long, white to light brown hairs.

Posterior eyes in a gently recurved line, equidistant, separated by the diameter. Anterior eyes in a gently procurved line, the median smaller than the lateral, separated by one and one-half times the diameter and from the lateral by a little less than the diameter.

Femur of palpus nearly straight and cylindrical. Patella short, strongly convex above. Tibia rather long, evenly convex above and more strongly concave below, viewed from above the mesal side nearly straight with the distal angle cut off, the lateral side concave; ventrolaterally the margin is thinned out and is somewhat widened distally. Tibia armed dorsolaterally at base with two black teeth borne on a very low tubercle. The black, rather stout embolus arises from a rather low quadrate bulb-like base on the mesal side of the bulb near the base. It enters the conductor near the apex of the bulb and divides into three branches which can be seen through its wall. The conductor lies close to the edge of the cymbium throughout its course; it is only moderately thickened basally and terminates in a rather long, nearly straight process which is thin, dorsally black, ventrally colorless and gently spirally twisted, the tip is very finely granulate, bluntly rounded with a point at one side.

Female. Length, 2.1–2.5 mm. Similar to the male in coloration, the pattern on the abdomen in some specimens more distinct. The epigastric plate orange, darker than rest of the venter, the median lobe of epigynum broad, notched posteriorly and limited on each side by a chitenized ridge which is continued laterally. The openings are beneath the anterior edge of the ridges.

Holotype male, allotype female. California: San Francisco, sand dunes, November 11, 1907; paratypes, 1 male, 1 female, same data. California: Christine, May 30, 1936, 1 male; Fort Ross, May 28, 1936, 1 male, 2 females; Gualala, May 29, 1936, 1 male, 13 females.

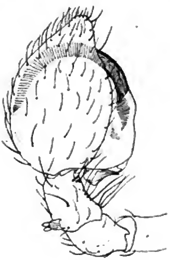
EXPLANATION OF FIGURES.

PLATE I.

Fig. 1. Dictyna cornupeta n. sp. Right palpus, dorsal view.
Fig. 2. Dictyna cornupeta n. sp. Right palpus, ventral view.
Fig. 3. Dictyna tridentata n. sp. Right palpus, dorsal view.
Fig. 4. Dictyna tridentata n. sp. Right palpus, ventral view.

PLATE II.

Fig. 5. Dictyna peragrata n. sp. Right palpus, dorsal view.
Fig. 6. Dictyna peragrata n. sp. Right palpus, ventral view.
Fig. 7. Dictyna peragrata n. sp. Epigynum, adult.
Fig. 8. Dictyna peragrata n. sp. Epigynum, immature.
Fig. 9. Dictyna francisca n. sp. Epigynum.
Fig. 10. Dictyna francisca n. sp. Right palpus, dorsal view.
Fig. 11. Dictyna francisca n. sp. Right palpus, ventral view.



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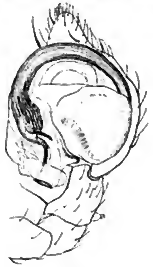

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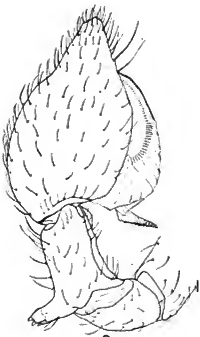

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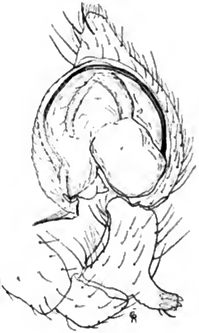

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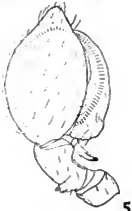

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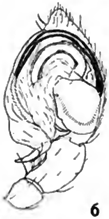

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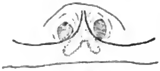

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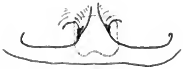

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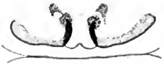

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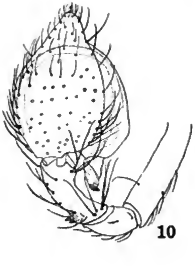

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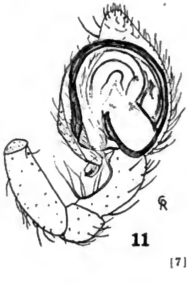

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